

COMMITTEE HEARING
 BEFORE THE
 ENERGY RESOURCES CONSERVATION AND DEVELOPMENT
 COMMISSION OF THE STATE OF CALIFORNIA

In the matter of,)
) Docket No. 14-IEP-1
)
Integrated Energy Policy)
<u>Report (IEPR)</u>)

CALIFORNIA ENERGY COMMISSION

HEARING ROOM A

1516 NINTH STREET

SACRAMENTO, CALIFORNIA

THURSDAY, APRIL 10, 2014

9:00 A.M.

APPEARANCES

Commissioners

Commissioner Janea Scott, Lead Commissioner for IEPR and
Transportation

Commissioner Karen Douglas

CEC Staff Present

Jim McKinney, Energy Commission

Presenters/Panel Members Present

Anthony Eggert, UC Davis

Aaron Harris, Air Liquide

Daniel Dedrick, Sandia National Laboratories/NREL H2
First

Matt McClory, Toyota

Brendan Shaffer, UC Irvine

Mark Duvall, Electric Power Research Institute

Richard Lowenthal, ChargePoint

Edward Kjaer, Southern California Edison

J.R. DeShazo, UC Los Angeles Luskin Center for
Innovation (via WebEx)

Dan Davids, Plug In America

Matt Miyasato, South Coast Air Quality Management
District

John Boesel, CALSTART

Mike Simon, TransPower

Jeff Reed, Sempra Energy Utility

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Nathan Parker, UC Davis Institute of Transportation
Studies

Harry Simpson, Crimson Renewable Energy

Tom Griffin, Edeniq

Julia Levin, Bioenergy Association of California

Also PresentPublic Comment

Kim Heroy-Rogalski, Air Resources Board

Mike Waugh, Air Resources Board

Anna Nigueriea (phonetic)

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1 P R O C E E D I N G S

2 APRIL 10, 2014

9:00 A.M.

3 (Mr. McKinney's presentation already in
4 progress.)

5 MR. MC KINNEY: Electric charging
6 infrastructure, that's also our charge. And the vehicle
7 supports on that for commercial vehicles is our sister
8 agency, the Air Resources Board and the AQIP or Air
9 Quality Improvement Program.

10 For zero emissions and here's we can -- and it's
11 really a collaborative effort between the Energy
12 Commission, the Air Resources Boards, (inaudible) -- in
13 particular and the others in California.

14 And then biofuels, we have the responsibility
15 for funding in that area. We'll talk more about that
16 later.

17 Something else we want to get out of our
18 workshop today, and from our panelists is what are your
19 recommendations on the strategic uses of this fund to
20 help achieve our State policy goals for climate change,
21 petroleum reduction and air quality.

22 So, to set the stage, we are currently the
23 eighth largest economy on a global scale, so we could
24 call this a nation state.

25 So the statistics, I think you're generally

1 familiar with this. We're coming up on 38 million
2 people in the populace.

3 The gross GDP is now \$2 trillion. --
4 (inaudible) are 448 million metric tons.

5 Unlike most of the rest of the country,
6 transportation is the predominant source of carbon
7 emissions in California. It's about 40% of all GHG
8 emissions.

9 We have an incredibly large vehicle fleet.
10 There's about 26 million passenger vehicles and about
11 one million trucks.

12 Our fuel consumption is also prodigious, 17.8
13 billion gallons in total. 14.5 of that is gasoline and
14 ethanol, 3.3 billion gallons is diesel fuel.

15 Policy drivers for this program and others, so
16 GHG or carbon reduction comes from AB 32. I think
17 you're familiar with these numbers, 30 percent reduction
18 by 2020 and then 80 percent reduction stretch goal by
19 2050.

20 Petroleum reduction and in-state biofuel
21 production.

22 And then we get to the Low Carbon Fuel Standard,
23 which is just a critical fuel that the State of
24 California as developed of the 10 percent reduction in
25 carbon intensity across the board on transportation

1 fuels by 2020.

2 Here are a couple important federal statutes and
3 drivers that affect California to a great extent. They
4 are the RFS2 renewable fuel standard that calls for 36
5 billion gallons of renewable fuel by 2022.

6 And something we've heard about and I think Dr.
7 Barry Wallerstein in his remarks, on March 27th, was
8 probably the most articulate about this.

9 He did the two air basins in California that are
10 in severe non-attainment, the San Joaquin Valley
11 (inaudible) -- they're going to need another 80 percent
12 reduction from the current baseline levels in NOx by
13 2023. So, all of the technologies we're going to talk
14 about today, it is about policy goals that really
15 (inaudible) --

16 And the Administration of Governor Brown has
17 also been critical in pushing the technologies forward.
18 So, he's laid down a marker with a goal of accommodating
19 1 million zero emission vehicles by 2020 and 1.5 million
20 by 2025.

21 So, Assembly Bill 8 was passed and that
22 reauthorized ARFVTP last year. And the goal of this is
23 to transform our market to the technologically advanced
24 set of markets that we'd have for zero emissions and try
25 to get further.

1 And develop and deploy innovative technologies
2 that transform California's fuel and vehicle types to
3 help attain the state's climate change policy goals.

4 So, here's some stats on what we've done with
5 our program thus far. We started issuing (inaudible) in
6 about 2009.

7 Thus far we've got \$413 million in grant
8 contracts out. And this is how they're displayed.

9 So, on the fuel side, when we were at about \$85
10 million in investment, it's about half of that was in
11 biomethane, 30 percent for biodiesel and the rest for
12 ethanols.

13 For fueling infrastructure it's about \$100
14 million and you can see the breakout there. So, most of
15 that is with electric charging infrastructure, the green
16 part of the bar, and then the blue is hydrogen fueling
17 infrastructure. That number's going to get a lot bigger
18 very quickly. And then the natural gasoline and propane
19 infrastructure, as well.

20 On the vehicle side, we're at about \$115 million
21 in investment. That's predominantly the medium duty and
22 heavy duty technology sector. But it also feeds our
23 contributions to the (inaudible) -- project at the Air
24 Resources Board and that investment's about \$25 million
25 to date and direct funds are about a \$50 million pool to

1 fund the ARFVTP.

2 Most of that is electric drive, a little bit on
3 hydrogen fuel cells which are predominantly buses and
4 trucks. And those programs will be part of our efforts
5 here and then a little bit on propane.

6 The manufacturing sector is about \$40 million
7 and that's predominantly been electric support so,
8 components for batteries and assembly plants for new
9 technology vehicles.

10 So, what do we think we're going to get from
11 this? This is a chart from our 2013 IEPR and it comes
12 from a graph from an NREL Guidance Report from Dr. Mark
13 (inaudible) at NREL.

14 So, expected benefits, so that's what we
15 expected to get to 2025, 2025 assuming that everything
16 under contract is built out according to plan.
17 (Inaudible) -- Department of Justice.

18 And there's also some additional factors called
19 the market transformation effect and that can be, you
20 know, as we get our electric drive out and demonstration
21 phases, the prices goes down, the market picks up,
22 regulatory drivers kick in and we have a synergistic
23 effect where the market's going to grow.

24 Part of that is directly attributable to what we
25 do in our program and part of it is these other

1 regulatory and market forces.

2 So, we think with that, total carbon reduction
3 from our program will range from 1.7 million metric tons
4 to a high (inaudible) in metric tons.

5 The green line there is the direct trajectory
6 curve that is articulated in revisions to the draft from
7 the Air Board.

8 So, under that case scenario, we're about a
9 third of the way (inaudible) by 2025/2030.

10 The good news is that if you look at the other
11 version of this chart, looking at 2050 and those lines
12 on the bottom, they're just really, really narrow and
13 they're really (inaudible) -- slope very steeply.

14 So a lot of work can be ahead of us, but I mean
15 that's the point of what we need to get at today.
16 Really, what's your best estimate of how far we can push
17 these technologies and link it over the next ten years
18 and beyond?

19 So, one of the -- and I'll kind of give you a
20 little background and some of the policy goals for each
21 of the four categories that we'll do and then we'll have
22 our first speaker, Anthony Eggert.

23 So, for hydrogen fueling infrastructure, our
24 strategy goals that would facilitate commercial launches
25 of light duty fuel cell vehicles in California, and this

1 truly a team effort with the Air Board, and the
2 California Fuel Cell Partnership, and the automakers,
3 and the development community.

4 So, this will help achieve the ZEV mandate goals
5 for zero emission vehicles, improve air quality, reduce
6 petroleum use and reduce carbon emissions.

7 The specific goal is a network of at least 100
8 stations by 2020. And this is from the AB 8 statutes,
9 and this is the first time there's been a specific carve
10 out for (inaudible) -- and then for hydrogen fueling
11 stations.

12 We're also learning to bring down station costs.
13 They're coming in about \$2.5 million apiece right now.
14 That's a lot of money and we believe that's not so good.
15 There's an observation on today's panel on how to reduce
16 that.

17 Here's where we are now. We've got nine
18 operational stations. We've got 20 stations funded and
19 in development with ARFVTP funding. That includes our
20 first 100 percent renewable hydrogen stations.

21 We have \$30 million in the pipeline. We've had
22 a large solicitation that was just released. We've had
23 a very good response. And Jeannie Barrett (phonetic)
24 has her team working with the ranking and scoring of
25 those.

1 Let me -- (inaudible) -- if you totaled up the
2 money that we have spent and the Air Board has spent,
3 the State investment in hydrogen infrastructure will be
4 over \$80 million to date. And I think that's a real
5 indicator of the State of California's commitment at the
6 policy level and at the financial incentive level to
7 really help spur this very, very (inaudible) -- market.

8 Here's where you can see the stations. So the
9 green ones are open, this is Southern California.

10 As always, my thanks to Kathleen and her team
11 for being able to see these maps.

12 So, they have eight operational in Southern
13 California, 15 are in development in Southern
14 California, and a couple more that are in planning.

15 And in Northern California, especially in
16 Silicon Valley, the demographics are equally, I think,
17 rich and ripe for early consumer uptake of fuel cell
18 vehicles.

19 We have one station in Emeryville and then four
20 more in development.

21 And for electric vehicle charging our strategic
22 goals is to support consumer acceptance of light duty
23 electric vehicles and complement the prodigious work of
24 the Air Board in the Clean Vehicle Rebate Project,
25 achieve the Governor's ZEV mandate targets. I already

1 articulated those.

2 And policy wise includes air quality, reduce
3 petroleum use and reduce carbon emissions.

4 For our program, this is what we've done thus
5 far. (Inaudible) -- back to the team.

6 So, we've spent almost \$27 million thus far and
7 that's only going to get us about 7,800 charge points
8 throughout California.

9 The green bars show the ones that are installed.
10 The blue bars are the ones underway.

11 We've done 11 regional readiness planning
12 grants. That's very important to get on-the-ground
13 knowledge and information out to the companies to figure
14 out where actually these chargers would be situated.

15 And we're also starting to get in on fast
16 chargers. We've done 77 of those and they're smaller.

17 The bigger picture, there's an important
18 settlement between NRG and the California Public
19 Utilities Commission. So, at full build out that will
20 give us another 200 fast charger stations and 10,000
21 level 2 EVSEs. That's the conduit and adds some
22 foundation for chargers (inaudible) --

23 Tesla has got a Supercharger Network. I checked
24 on their website last night and they've got 10
25 operational stations now in California.

1 Something that's a little harder for us to get
2 data on is what the charger companies have done
3 (inaudible) --

4 And the Air Districts are contributing in an
5 important way to building out EVSE.

6 So, I think a lot of you are familiar with this
7 chart or versions of this chart. This is done from the
8 CCSE down in San Diego. There's a point factor for the
9 CVRP, the Air Board.

10 The numbers are -- the market is really picking
11 up. So, as of now we're putting out about a thousand
12 voucher rebates. And here it's battery electric and
13 plug-in electric.

14 That's over \$100 million. And I think it puts
15 the vehicle count at about 64 or 65 thousand in
16 California right now.

17 So, our policy goals; facilitate technology
18 development and commercialization of medium duty and
19 heavy duty vehicles for goods movement and freight
20 transportation.

21 There are multiple pathways that we're actually
22 supporting with this, so natural gas, electric drive,
23 hydrogen fuel cell electric drive and then all the
24 different combinations of these technologies that we can
25 use, so for hybrid and range extender combinations.

1 Policy goals are reduce diesel fuel use, and I
2 think (inaudible) -- that trucks comprise about three,
3 three and a half percent of the total vehicle fleets in
4 California. So, the used about 16 percent of the fuel
5 and are responsible for up to 24 to 25 percent of the
6 total criteria and particulate emissions in California.

7 So, it's kind of a disproportionate --
8 (inaudible) -- so we think that by investing in this
9 sector using lower carbon, zero carbon technologies
10 power we can lower the carbon and the poor air quality
11 levels.

12 And a lot of information here, but I basically
13 want to say that these put about 2,000 trucks on the
14 road between natural gas and propane. And we just have
15 some great projects in the pipeline on the development
16 side.

17 On the assembly plant side, so companies called
18 Motor Electric (phonetic), life Vehicles International,
19 Motor Power in the Bay Area, Light Speed (phonetic),
20 we've got really exciting (inaudible) -- in the
21 marketplace.

22 So, we've put about \$7 million into that and
23 about \$40 million into the truck sector.

24 The takeaway here is that they put about 1,600
25 trucks on the road with all commercial scale trucks,

1 nearly \$50 million in funding.

2 So, you know, we're moving the needle away from
3 zero. But again, it's a long way to go to put a dent in
4 the truck vehicle fleet.

5 As to biofuels, so our strategic goals and
6 policy goals are to displace petroleum as predominant
7 vehicle fuel in California, support the low carbon fuel
8 standard and its target of 10 percent reduction by 2020,
9 develop commercial products and markets for ethanol and
10 green gasoline, biodiesel and renewable diesel, and
11 biogas.

12 Policy goals, again, reduce diesel fuel use,
13 enhance public health, improve air quality and reduce
14 carbon emissions.

15 This is a snapshot of what we've got so far. So
16 on capacity basis we can get about 240 million gallons
17 per year in capacity.

18 In California, their production is below that,
19 it's about 150. We're very pleased to see that Pacific
20 Ethanol, the second plant in the (inaudible) is back
21 online. That's a big time market signal.

22 But our in-state use is over a billion gallons
23 of ethanol per year. So there's a lot of increased move
24 and that's primarily for (inaudible) --

25 On the biodiesel side we've got about 50 million

1 gallons per year of capacity and production's about
2 half.

3 The graph's about what we've funded for far, so
4 about \$100 million for fuel production and about 34
5 projects.

6 In addition, we've got the infrastructure to
7 support that.

8 So, the way the program will run today is our
9 first speaker is going to be Anthony Eggert from UC
10 Davis.

11 And before I introduce him formally, I just want
12 to say I think this is a really exciting mix of
13 panelists. And I counted up, we have three CEOs and we
14 have one chief technology officer. We have two former
15 commissioners and appointees. We have representatives
16 from major global corporations, like Air Liquide and
17 Toyota.

18 And we're going to hear from speakers from two
19 very progressive utilities in California, the Southern
20 California Edison and the Sempra Utilities.

21 And I was making the bios, I was really, truly
22 pleased to see the credentials that these folks have.

23 So, I'm really looking forward to today.

24 So, the way the rest of the day will run is I'll
25 introduce the panels. And, again, we'll start with Mr.

1 Eggert.

2 I'll introduce each panel, and review the
3 strategic goals and key questions that we distributed to
4 the speakers early on. We'll hear from the speakers.
5 We'll then take questions from the Commissioners. I may
6 have a few questions.

7 And I think, generally, we're going to be tight
8 on time, so questions are going to have to come later in
9 the afternoon.

10 So, with that I want to introduce Anthony
11 Eggert.

12 MS. RAITT: I think we need to take a one-minute
13 break.

14 (Off the record.)

15 MR. MC KINNEY: Okay, are we good? Great.

16 I'd like to introduce our first speaker, Mr.
17 Anthony Eggert.

18 Anthony Eggert is the Executive Director of the
19 UC Davis Policy Institute for Energy, Environment and
20 the Economy, which is dedicated to leveraging University
21 of California experience to inform better policy.

22 Anthony has served as an appointee of Governor
23 Brown and Governor Schwarzenegger in several senior
24 policy positions, including Science and Technology
25 Policy Advisor for the Chair of the Air Resources Board,

1 Commissioner for the California Energy Commission, and
2 Deputy Secretary for Energy Policy of the California
3 Environmental Protection Agency.

4 His prior positions include advising the
5 University of California on Federal energy and climate
6 policy, directing research on low carbon fuels and
7 vehicles at UC Davis, and as an Engineer and Manager at
8 Ford Motor Company.

9 Anthony serves as a Board Member of the Alliance
10 to Save Energy, the National Commission on Energy
11 Efficiency Policy, and is a Technical Advisor to the
12 U.S. Department of Energy and the National Renewable
13 Energy Laboratories.

14 Welcome Anthony.

15 MR. EGGERT: Thank you very much, Jim. And it's
16 great to be back here in these chambers and see so many
17 familiar and friendly faces. And I want to thank the
18 Commissioners for inviting me to present on some work
19 that we've done.

20 Looking out to kind of where we want to go to
21 2050 I think, you know, to answer the question about
22 what we can do in the next ten years we kind of have to
23 know where you want to end up.

24 And so, what I'm going to be presenting on today
25 here is the results of a modeling forum that we held in

1 December, with participation from the Energy Commission,
2 many of the other State agencies, the Governor's Office,
3 and a number of the modeling teams that have looked at
4 this question: which is can California achieve its long-
5 term energy and climate goals and what might that mean
6 for technology and policy pathways.

7 I'm going to go through this relatively quickly,
8 both because I know we're running a bit behind on time,
9 but I want to make sure I get, you know, to the key
10 findings that are of relevance to the IEPR process.

11 In fact, I'll just jump right to the punchline.
12 And that is that, pretty much I would say, universally
13 across all the different analyses that have been done on
14 this that we -- if we're going to get to our long-term
15 climate goals within the transportation sector, we have
16 to accelerate our progress towards zero emission
17 vehicles, particularly for the light duty sector.

18 And even increasingly we're finding that that's
19 necessary in portions of the goods movement, heavy duty
20 sector, as well as advanced biofuels, particularly low
21 carbon biofuels that don't contribute significantly to
22 emissions from a land use change.

23 So, that's the conclusion. Let's see if I can
24 now walk you through it.

25 I do want to just acknowledge this is a project

1 that involved a quite a number of folks, steering team,
2 all the other modeling teams.

3 I'll point out one of my colleagues here, Jeff
4 Morrison, who's a post-doc, who did a quite a bit of the
5 analytical work. He also happens to be looking for a
6 job, if anybody --

7 And so, just a couple of very, very brief
8 comments about models, and this is a quote from a late
9 and distinguished professor at the University of
10 Wisconsin, Madison, George Box, who was really quite
11 well known for the development of statistical modeling
12 and using Bayesian inference tools and techniques, which
13 is basically saying that you should always be updating
14 and looking for opportunities to update your model with
15 recent experience, data and knowledge.

16 And I think it's important to recognize that,
17 you know, it is -- this is a true statement: models are
18 an attempt to basically provide a simplified view of
19 reality. And whether we know it or not we use models
20 all the time.

21 Even to get here to work today I had to create a
22 model about how long it was going to take me from when I
23 left my house to when I arrived here in the room.

24 Fortunately, most of assumptions and parameters
25 were correct. Otherwise, you'd be looking at an empty

1 podium.

2 But when we think about models for the purposes
3 of informing decision making, the best models are those
4 that are sufficiently transparent to provide an
5 understanding about the assumptions, the methodologies
6 and the implications for different inputs.

7 They allow you to ask what if questions and see
8 what the results are, and be able to understand those
9 results in a sense that you can actually use them for
10 the purpose of decision making.

11 And I would say, you know, without them you're
12 really stuck with opinion and conjecture, which I would
13 suggest is not the best basis for important decision
14 making.

15 Again, just sort of a very quick terminology,
16 you know, we also talk about scenarios and this is, I
17 guess, a relatively recent term from the 1970s, at least
18 made famous by Shell Oil when they used scenarios to
19 understand what the future trajectory of different oil
20 supply situations might be then used that for the basis
21 of decision making.

22 And what scenarios do is they recognize that the
23 future is informed, is shaped by decisions. And
24 certainly, for government, it's also shaped by policy
25 that helps to shape decisions that lead to different

1 outcomes.

2 And then just a very quick word about
3 predictions; I would say that the history of predictive
4 models is sort of fraught with challenges.

5 This is just a chart that shows the attempts by
6 the Department of Energy to predict the future price of
7 oil. The little whiskers are where they thought it was
8 going to go and the solid line is what actually
9 happened.

10 And it sort of reflects some of the challenges
11 when you're trying to do predictive things, like
12 pricing.

13 I would say DOE has mostly learned its lesson
14 and now they do, basically, scenarios analysis where
15 they use different assumptions to establish low and high
16 price trajectories, which gives them quite a bit of
17 latitude.

18 And then I also think some humility is
19 appropriate. There's always going to be things that we
20 didn't anticipate, even though we may think that we've
21 found the best way to power our energy future using
22 porcupines and Raisin Bran, there's always the
23 possibility that porcupines might be allergic to raisins
24 and our theory falls apart.

25 So, when we looked at this question, we really

1 did focus on this idea of California's contribution to a
2 stabilized climate, which is mentioned in the policy
3 goals for the State, which is an 80 percent reduction in
4 emissions out to 2050, comparative to 1990 levels.

5 And we sort of also were informed by a desire, a
6 stated desire by the State to determine where they
7 should be in the next 16 years, sort of, or at least at
8 different mid points along the path.

9 And this is articulated both in a policy
10 document by the Air Resources Board, as well as the
11 Governor's Office, their Environmental Goals and Policy
12 Report identifying the need to establish sort of midterm
13 targets to guide policy development.

14 So, across all these models we asked the teams
15 to look at what they thought -- where the State might be
16 in 2030 and 2050 with respect to greenhouse gases, fuel
17 mix and technology mix, infrastructure built rate, air
18 quality. What were the key assumptions that drive those
19 results? What are some of the common insights? And
20 where do they diverge?

21 Again, I'm going to be focusing primarily on
22 those results that are relevant to transportation and a
23 little bit on power generation.

24 But you can get all of the information,
25 including the findings, the summaries, all of the model

1 documentation from our website.

2 Again, in the interest of time I won't go
3 through this. But you find that when you start to look
4 at these things you realize that there's quite a
5 different -- quite a number of different modeling tools,
6 methodologies and philosophies, all of which have kind
7 of different merits, pros and cons.

8 And understanding what those are I think is very
9 helpful when you're thinking about what types of
10 questions you might want to ask of the models.

11 And so, the other sort of benefit of undertaking
12 this exercise was just the -- by looking at these in
13 detail, we were able to uncover and I think discover
14 some additional value from each of these exercises.

15 Assumptions do matter. Some significant ones,
16 certainly, are things about, for example, the future
17 population of the State, which based on the latest
18 census has actually been falling, at least in terms of
19 its future estimate.

20 It's now estimated to be about 50 million across
21 the State, going from about 36 today, by 2050.

22 That can impact things like business as usual,
23 what you think would happen otherwise, without any
24 additional policy.

25 And one interesting thing about assumptions

1 about business as usual is that as additional policies
2 have become sort of ingrained in the activities of the
3 energy sector, it's caused a substantial reduction in
4 the estimate of that future business as usual.

5 And that gives you, in a sense, of sort of how
6 much harder you have to work to get on the path to 2050.

7 So, this is just reflective of a straight line
8 and a constant rate reduction to 2050. And then these
9 are the scenarios that actually either hit the mark or,
10 in the one instance, a model that we included from
11 Lawrence Berkeley Lab, which only looked at, really,
12 policies out to 2030, actually still had similarly --
13 cumulatively similar reductions to 2050.

14 And one of the things you'll note is that you
15 can kind of look at this either from the perspective of
16 an annual emissions target or a cumulate emissions
17 reduction.

18 And this definitely matters for a variety of
19 reasons, but it particularly matters for the climate.
20 The climate care is primarily about the buildup of
21 atmospheric concentration of greenhouse gas emissions
22 that contributes to the radiative forcing, which causes
23 climate change.

24 And, therefore, cumulative emissions is
25 sometimes even a better estimate of how your policies

1 are contributing to that goal.

2 And actually, among these models the difference
3 in the cumulative emissions was as much as 40 percent.

4 In terms of the specific question that we were
5 asked about 2030 targets, what you'll see there on the
6 left, this just shows the envelope of results.

7 We're, I think, able to give a fairly wide range
8 of values, anywhere from about 8 to 52 percent below
9 1990 levels by 2030.

10 And that's reflective of a lot of different
11 paths to the end goal. And depending on how these
12 models work, they tend to favor either early reductions
13 or later reductions.

14 And again, just want to point out that that does
15 make a difference when you look at the cumulative side.

16 Okay, so let's jump to the results. So, these
17 are -- this is a fairly busy slide, so I'm going to just
18 try to draw you to the primary findings.

19 This is for the transportation sector. The bar
20 on the left is the light duty energy use and then the
21 little red triangle on the left, at the top there is
22 reflective of the energy consumption across all
23 transportation modes in 2010.

24 And then each of the subsequent bar charts and
25 triangles is reflective of each of the models' estimates

1 for 2030 and 2050 for the transportation sector, again,
2 the light duty sector being the gold bars.

3 And so what you find is that by 2030 -- I think
4 for some people this might be a surprising finding, but
5 it's still a relatively small fraction of the overall
6 light duty vehicle fleet, which is comprised of zero
7 emission vehicles, primarily battery-electric or
8 hydrogen fuel cell vehicles.

9 But by 2050 they dominate the market. So,
10 across the model somewhere between 57 and 87 percent of
11 all vehicles on the road are zero emission vehicles
12 across these different models.

13 The other thing is that the transportation
14 energy use falls dramatically across pretty much all of
15 the models, some of them by more than half.

16 This is despite the dramatic growth in
17 population. And this reflects a dramatic increase in
18 the efficiency across all modes for the transportation
19 sector.

20 And that includes both conventional vehicles
21 using combustion technology, as well as the more
22 advanced technologies like batteries and fuel cells.

23 So, then the question is what's the rest of the
24 energy that's not either hydrogen or electricity, coming
25 primarily from low carbon sources?

1 And again I would say across almost all the
2 models they saw a very significant role for biofuels,
3 liquid biofuels and -- but also were sort of reflective
4 of the resource limitations, the feedstock limitations
5 for the production of those biofuels that could be truly
6 low carbon.

7 And generally they saw that as being limited to
8 about 40 percent of the overall transportation energy
9 need in 2050, and comprised primarily of things like
10 waste materials, plus some of what are characterized as
11 energy crops to the extent that, again, they don't have
12 significant contributions to land use emissions.

13 On the power generation side, so the electricity
14 sector, here it's a very, very different story. So,
15 again, the little red box on the left for 2013 is the
16 current electricity generation, kilowatt hours per year
17 in California.

18 I note that the bottom is not at zero. It's at
19 250 terawatt hours.

20 The number above that is, at that time, the
21 generation associated with renewables, 20 percent.

22 And then each of the successive box spots on the
23 right are each of the different pathways.

24 And what you'll see is that across all the
25 different models electricity consumption grows

1 dramatically. In some cases it's quite a bit more than
2 twice the amount of electricity consumption by 2050,
3 despite dramatic assumptions about efficiency for
4 buildings, for appliances, et cetera.

5 And this is really associated with two factors
6 that being sort of the electrification of a lot of our
7 end uses, especially in the transportation sector, but
8 also, particularly in residential, commercial and
9 industrial heating processes.

10 The other thing I would -- I know the other part
11 of the IEPR is to look at things like the DIRECT and the
12 future potential for renewable energy generation.

13 So that the numbers, the percentages that are
14 above those plots reflect the estimates of what the
15 renewables fraction would be in each of those years.

16 And there's a quite a wide range and a lot of
17 that has to do with the extent to which the models
18 assumed there would be availability of things like
19 nuclear generation, and carbon capture and
20 sequestration.

21 But even under the fairly modest assumptions I
22 would say the build rate for renewables is quite
23 dramatic. So, anywhere between 200 megawatts and 4.2
24 gigawatts per year between today and 2030, and one and a
25 half and 10.4 gigawatts per year between 2030 and 2050.

1 This is really, I would say, unprecedented. We
2 do have the resource base in this State, but this is
3 sort of a call to action, you might say. If we believe
4 we need to be on this path, we really need to think
5 about a dramatic uptick in the build rate for renewable
6 generation.

7 And then, finally, and very importantly, of
8 course, we do still have the air quality challenges that
9 Jim mentioned.

10 And for those models that did address air
11 quality, not all of them did, but those that did I think
12 reinforced the statement that Jim mentioned and that
13 Barry did in the first meeting, which is that we really
14 need the zero and near zero emissions freight, goods
15 movement technologies earlier than we might have
16 otherwise thought, especially in the San Joaquin Valley
17 and South Coast Air Basins.

18 And again, that has implications for how quickly
19 we need to build out and deploy those technologies.

20 So, just to conclude, again I want to emphasize
21 that you should never really rely upon any singular
22 model. They do all provide some interesting
23 perspectives, especially if they've sort of opened up
24 their books and allowed you to see inside how they
25 actually work.

1 A variety of these different models suggest that
2 it is technical plausible to get to these deep
3 production levels. That's not going to say it's going
4 to be easy, but it is possible. And we've been able to
5 sort of identify what that means in terms of technology
6 deployment.

7 And then, of course, you know, as good
8 researchers we always have to identify opportunities for
9 additional research. There was quite a few of them.

10 I just highlight one, which relates to bioenergy
11 and biofuels production, a need to really sort of dig
12 into that because there's a variety of different
13 pathways that biomass can take into the energy sector.

14 And depending upon certain assumptions about
15 things like bioenergy plus CCS that can sort of tip the
16 model in different directions as to where that ends up.

17 And then I guess I'm just going to conclude with
18 the last two bullets here, which is the essential need
19 for a continued collection of data.

20 And this is something where I see CEC has just a
21 tremendous opportunity, given its programs that it's
22 undertaking, that you are in the process of building
23 what could be a really, really valuable dataset about
24 sort of where we're at on the path towards these
25 futures.

1 And if we can collect that data in a transparent
2 form that can then be fed back into both the modeling
3 efforts and the decision making, I think we have a real
4 chance for the State of California and the Energy
5 Commission to be an active and productive player in that
6 process.

7 And then the very last point I'll make is that
8 we're already getting requests from other jurisdictions
9 that are very interested in this work and how it might
10 apply to other states, like Washington, Oregon. Of
11 course, even across the rest of the country because if
12 we are going to reach our climate goals, these
13 technologies eventually have to be adopted elsewhere as
14 well.

15 So, I think with that I will conclude. Thank
16 you very much.

17 MR. MC KINNEY: Thank you very much, Anthony.

18 Commissioner Scott or Douglas, do you have any
19 follow-up questions?

20 COMMISSIONER SCOTT: I do not have any follow-up
21 questions, but I would just say thank you very much for
22 this thorough and really interesting presentation. For
23 me, it's a great way to set the stage and really
24 understand kind of the broader context for the
25 discussions that we're going to have in our panels

1 today. So thank you.

2 MR. EGGERT: Thanks a lot, thank you.

3 MR. MC KINNEY: And Anthony, this is not so much
4 a question, but I think you truly kind of laid a good
5 framework for later on today.

6 And two of the stats you put out that caught my
7 attention. I think you said 40 percent of
8 transportation energy from the biofuels sector in 2050.
9 Was that the modeling result?

10 MR. EGGERT: Yes, as a potential for biofuels
11 that could be produced in a way that would be consistent
12 with the long-term climate goals.

13 MR. MC KINNEY: Yeah, and I think that will be
14 really interesting on our fourth panel today because
15 there's not a lot of good market connections right now
16 between kind of our nation biofuels industry and the
17 fleets, and the blenders that have to pick that up and
18 get it into the gas tank. So, that will be good.

19 And also, the projections on hydrogen fuel cell
20 vehicles by 2020. And given how hard all of us are
21 working just to get that puppy up and running, and just
22 crawling, really. That's good to see that the models
23 are showing that.

24 MR. EGGERT: Yeah, so maybe just two quick
25 comments. So, one, I'll put a plug in for my other

1 colleague who's going to be here presenting later today,
2 Nathan Parker, who's going to talk about some of the
3 transitional challenges and opportunities associated
4 with moving towards the other biofuel sources and what
5 their resource potential is.

6 And then I think, you know, to the point about
7 we're -- we have to think about this on sort of a multi-
8 decadal time frame. You know, we're talking about
9 nothing less than transforming one of the largest
10 industries in the world, which is both the
11 transportation sector and the energy sector that serves
12 it.

13 And, again, having some understanding about the
14 pace at which we can introduce things and when they're
15 likely to have an impact I think can really help sort of
16 guide both our ambitions and our specific investments.

17 MR. MC KINNEY: Yeah, great, thanks Anthony.

18 So, with that I would like to call our hydrogen
19 speakers up to the tables here.

20 You will be our first panel. So, we need
21 Brendan Shaffer, Aaron Harris, Daniel Dedrick and Matt
22 McClory.

23 Do you see your name tags there?

24 Heather, would you prefer that people present
25 from the table or the podium?

1 MS. RAITT: Either way is fine. We can turn
2 your slides or if you wanted to come here and use this,
3 that's fine, too.

4 MR. MC KINNEY: So, Brendan, we'd like to have
5 you go first. Would you prefer speaking from the table
6 and Heather or Lynette can run through your slides?

7 MR. SHAFFER: Yeah, this is fine.

8 MR. MC KINNEY: So, to review the policy goals
9 here, so again to facilitate commercial launch of light
10 duty vehicles. And, really, work towards this network
11 of a minimum of 100 stations by 2020, as laid out in AB
12 8, and really begin to drive down station costs.

13 So, some of the key questions, Commissioners
14 that we had prepared for this panel:

15 Are there critical technology issues that need
16 to be resolved in order to drive down station cost or
17 the cost issues of function of low volume and non-
18 standard station designs?

19 Number two: How can ARFVTP funding be used to
20 overcome specific technology and market barriers?

21 And three: What role can hydrogen fuel cell
22 vehicles play in helping to meet California's climate
23 policy goals through 2023 and beyond?

24 So, we have four speakers for this panel. We
25 have an hour and a quarter. I'm going to keep you to 15

1 minutes and then we'll have some room for, again,
2 follow-up questions from the Commissioners.

3 Our first speaker is Mr. Brendan Shaffer. He's
4 the Technology Manager of Sustainable Energy and
5 Transportation at the Advanced Power and Energy Program
6 at UC Irvine.

7 He has been performing research in the
8 alternative energy space since 2006. His research has
9 covered modeling of all the electric and transportation
10 systems, high temperature fuel cell development and
11 modeling, hydrogen fuel turbine systems, and advanced
12 dispatch for distributed energy resources.

13 He is a Licensed Mechanical Engineer for the
14 State of California and he received his MS and BS in
15 Mechanical Engineering from UC Irvine.

16 Brendan.

17 MR. SHAFFER: Thank you, Jim.

18 MR. MC KINNEY: Let's get the mic closer to you.

19 MR. SHAFFER: Okay, so Jim asked me to talk a
20 little bit about hydrogen fuel cell technologies and the
21 status of them, as well as some opportunities associated
22 with them.

23 And I'm going to discuss the applications, not
24 only in the transportation sector, but also some
25 applications in the stationary power sector.

1 So, why hydrogen fuel cells? Well, Anthony kind
2 of alluded to this in the previous presentation is we
3 have quite a few air quality challenges in the State,
4 and we also have a lot of climate change goals in the
5 State.

6 And there's like a lot of animations in this.
7 Who's controlling this? Sorry, I thought I was going to
8 have control of the -- but okay.

9 MR. MC KINNEY: If you'd like to go to the
10 podium, you can.

11 MR. SHAFFER: Yeah, I'll do that.

12 Okay, sorry about that. So, to address these
13 challenges, hydrogen fuel cells can really play a
14 significant role in addressing these challenges.

15 Battery electric vehicles can also play a
16 significant role here, as well, but for the purposes of
17 this presentation I'm going to focus on hydrogen fuel
18 cell technologies.

19 An important aspect to note here with actually
20 both of these technologies, battery electric and fuel
21 cell electric vehicles is that the electrification of
22 the fleet, of the light duty vehicle fleet provides a
23 lot of opportunities for grid support.

24 So, whether you're doing vehicle to grid, or
25 large scale central electrolysis, you can really provide

1 a lot of support for the grid, especially at the higher
2 renewable penetrations.

3 Another thing to note here is that a lot of the
4 modeling I showed that you're really still going to need
5 at least some natural gas resources to support grid
6 operation in the future, even at the high renewable
7 penetration.

8 And stationary fuel cells can really meet this
9 need. And in particular, the TIGER station application
10 is a very interesting one. And I'll discuss that
11 application later in the presentation.

12 And finally, managing the internet intermittent
13 renewables on the electric grid will require large
14 amounts of storage to avoid excessive curtailment of
15 those resources.

16 And batteries can serve this role, some hydro
17 can serve this roll, hydrogen can serve this roll.

18 And in the mad rush to get this presentation
19 ready, I somehow missed compressed air energy storage.

20 But I'd really like to focus on the hydrogen
21 aspect here. Hydrogen has some -- hydrogen energy
22 storage have some very important qualities that make it
23 very, very interesting.

24 So, looking at the wheel of carbon intensities
25 for various fuel vehicle systems, we can see that

1 hydrogen can provide some nice reductions from the
2 current fuel vehicle systems we're using today and the
3 gasoline vehicles.

4 But where we are now at getting our hydrogen
5 from natural gas won't really be enough to get us to the
6 reduction goals that we need to meet, in particular, the
7 80 percent reduction in 2050.

8 So, we really need to get down to getting our
9 hydrogen from renewable sources, whether it's biogas or
10 using electrolysis of renewable electricity.

11 So, just to quickly go through some possible
12 reduction potential using fuel cell electric vehicles,
13 we've done some dual sector analyses using our
14 transportation electric system model.

15 And the dual sector analysis is really
16 important, especially when you're considering
17 electrified vehicles because those vehicles are highly
18 coupled to the electric system, itself.

19 And the bottom line here is that fuel cell
20 electric vehicles can provide a large potential for GHG
21 reduction if you're producing that hydrogen from the
22 right source.

23 So, a particular case, and these are rough
24 numbers, and presented here just because they work well
25 together.

1 So, 60 percent fuel cell electric vehicle
2 penetration at 60 percent renewable penetration can give
3 you approximately a 60 percent reduction in greenhouse
4 gas emissions.

5 And a really interesting thing to note here is
6 that for this particular case there were still some SMR
7 in this case, so about 30 percent SMR, 30 percent
8 electrolysis.

9 And what we saw in the results is that if you
10 dispatch your electrolysis system, so there we're
11 talking about large-scale electrolysis systems.

12 If you dispatch those large-scale electrolysis
13 systems, you can really take advantage of a lot of that
14 otherwise curtailed energy from the intermittent
15 renewables.

16 In addition, we also saw that the hydrogen
17 fueling infrastructure, itself, has a large potential
18 storage potential.

19 So, these are some nice synergies that allowed,
20 you know, fuel cell vehicles to enhance renewable
21 deployment, if you will.

22 So, I pulled this figure from the Fuel Cell
23 Technologies Market Report, from the USDOE, just to
24 highlight the building momentum in the fuel cell sector.

25 And you can really see that, you know, the

1 amount of systems shipped is continuing to increase.
2 And once these volumes are increased sufficiently,
3 production costs are going to drop enough and you're
4 going to start to see profitability in some of these
5 companies.

6 So, I'm going to move to stationary fuel cells
7 real quick. So, here's a schematic of what a mobile
8 fuel cell system looks like.

9 In the stationary application you need to pre-
10 treat the fuel, since hydrogen does not occur naturally.
11 Typically, your fuel will be natural gas or biogas. You
12 also need to convert that direct current to a
13 (inaudible) current for integration with the current
14 electric system.

15 An attribute of stationary fuel cells is they
16 have efficiency, virtually zero pollutant emission and
17 virtually zero acoustic emission.

18 So, in a stationary application you have natural
19 gas coming in and alternating current coming out.

20 There's also some other attributes of the
21 stationary fuel cells, which it can also provide a high
22 quality waste heat stream. So, you can use that to
23 raise steam provide heat for HVAC applications, cooling
24 for HVAC applications if you integrate it with an
25 absorption chiller.

1 They also have a very low water consumption
2 which is increasingly an issue in the State of
3 California.

4 They're also, typically, now baseloaded systems,
5 24/7 operation and highly reliable.

6 And given their power conditioning systems to
7 take the direct current to alternating current it can
8 also provide power quality benefits.

9 So, in the stationary fuel cell market right now
10 there's three chemistries that are commercially offered.
11 Phosphoric acid is the first one, molten carbonate is
12 the second one and solid oxide fuel cell is the third
13 one.

14 And these names are associated with the type of
15 electrolytes in the fuel cells, themselves. And the
16 electrolyte determines the operating temperature. And
17 you have three manufacturers of each.

18 So, you have ClearEdge Power which provides the
19 phosphoric acid fuel cell; FuelCell Energy which
20 provides a molten carbonate fuel cell; and Bloom Energy
21 which provides the solid oxide fuel cell products.

22 Here's a map showing some of the installations
23 throughout the State. You can see that there's 38
24 megawatts of natural gas in the State and 43 megawatts
25 of renewably-fueled stationary fuel cells in the State.

1 Some of the applications are shown there on the
2 right. And let's look through some of the examples.
3 So, outside of Sacramento there's a ClearEdge power
4 system at a hospital, another ClearEdge power system at
5 an Albertson's in San Diego.

6 A FuelCell Energy system at California State
7 University, Northridge, another FuelCell Energy system
8 at a wastewater treatment system in Ontario and that
9 one's renewably fueled.

10 So, we have all three major manufacturers
11 showing a product in California. And two of these
12 companies are actually based in the State of California,
13 Bloom Energy and ClearEdge Power.

14 So, this is showing stationary fuel cell
15 shipments for -- by number of systems shipped, as well
16 as megawatts of fuel cells shipped.

17 And we can see here that the United States,
18 South Korea and Japan are the major markets right now.

19 In the U.S., California is actually a major
20 market, as I kind of alluded to in the previous slide.

21 Some interesting things from this slide, you can
22 see that Japan is shipping a lot of small units for
23 distributed generation applications, while South Korea
24 is shipping a very few large units for applications at
25 potential generation scale.

1 And that kind of segues nicely into the next
2 slide, where I introduce the TIGER Station concept.

3 So, if we look at the schematic of our electric
4 system, we have central generation in the transmission
5 system on the right and distributed generation in the
6 distribution system on the left.

7 And typically, so far stationary fuel cells have
8 been installed in distributed generation applications to
9 either a home or a business.

10 They've also been installed at wastewater
11 treatment facilities for the renewable case.

12 And the TIGER Station application looks to
13 install a fuel cell at a substation where the
14 transmission system and distribution system meet.

15 And TIGER Station is an acronym for Transmission
16 Integrated Grid Energy Resource.

17 And there's two major motivations for installing
18 a fuel cell at a substation. The first is that putting
19 a fuel cell there allows the utility to communicate with
20 that system and dispatch it as it needs to.

21 And then the second is that a lot of these
22 substations are located in urban air sheds with air
23 quality challenges. And fuel cells, as we all know,
24 have very low pollutant emissions and they're easily
25 sited within those areas.

1 Another application I need to mention here is
2 the fuel cell gas turbine hybrid. This system could be
3 well utilized both as a TIGER station, as well as a
4 central generation site.

5 They have the potential to exceed 70 percent
6 fuel to electricity efficiency, which is very
7 impressive. Here's an example of a TIGER Station in
8 Bridgeport, Connecticut and another example in South
9 Korea. And this one is 59 megawatts and I think it's
10 the largest one in the world at this point.

11 So, we did some modeling to demonstrate how
12 TIGER Stations could contribute to CO2 reductions,
13 despite them typically being fueled on natural gas at
14 this point.

15 So, we looked at a base case of 33 percent
16 renewable penetration, no coal, and a 5 gigawatt
17 deployment of these fuel cell technologies.

18 And what we can see is that from the base case,
19 which is in the gray, we can achieve a 6 percent
20 reduction despite the systems being natural gas fueled,
21 just due to their high efficiency.

22 NOx emissions would actually be a much greater
23 reduction. I'm not showing those here.

24 And then if you look all the way to the right on
25 this plot, on the light green, you can achieve a 13

1 percent reduction if you implement advanced control of
2 those systems such that you can -- you would curtail
3 their power during periods of excessive curtailment of
4 renewables on the grid. So, that's an advance dispatch
5 case that isn't typically how stationary fuel cells are
6 operated now, but could be operated in the future.

7 So that's it, thank you.

8 MR. MC KINNEY: Thank you very much, Brendan.

9 COMMISSIONER SCOTT: Brendan, can I ask you one
10 clarifying question?

11 MR. SHAFFER: Sure.

12 COMMISSIONER SCOTT: You had on slide three, the
13 hydrogen supply chain analysis --

14 MR. SHAFFER: Yes.

15 COMMISSIONER SCOTT: -- and it talked a little
16 bit about the plug-in hybrids with 40-mile electric
17 range with the California grid and battery electric
18 vehicles with the California grid.

19 MR. SHAFFER: Yes.

20 COMMISSIONER SCOTT: And my question there was
21 is that today's grid, is that the grid of 33 percent, is
22 that the --

23 MR. SHAFFER: Yes.

24 COMMISSIONER SCOTT: Okay.

25 MR. SHAFFER: That's today's grid.

1 COMMISSIONER SCOTT: Okay.

2 MR. SHAFFER: So, you know, if the renewable
3 portion goes up those are going to start to shift to the
4 left.

5 COMMISSIONER SCOTT: Okay.

6 MR. SHAFFER: Which is why you really need to
7 start working toward renewable production of hydrogen
8 which, you know, the CEC in their recent solicitation
9 required 33 percent of the hydrogen to be renewably
10 produced.

11 COMMISSIONER SCOTT: Thank you.

12 MR. SHAFFER: Yep.

13 MR. MC KINNEY: Great. Our next speaker will be
14 Aaron Harris, Air Liquide. So, Aaron, you can either go
15 to the podium or speak from the table.

16 Aaron developed his passion for U.S. energy
17 independent while serving in the Marine Corps. While
18 researching his career options he stumbled into hydrogen
19 fuel cells and became enamored with the technology.

20 In his view, the potential for hydrogen served
21 both environmental and national security interests,
22 which brought on his pursuit of Bachelor's and Master's
23 Degrees in Mechanical Engineering from the University of
24 Washington.

25 Aaron has held various positions in several

1 companies, including International Fuel Cells, the
2 Boeing Company, Nuvera Fuel Cells, and Sandia National
3 Laboratories.

4 Aaron is currently the Hydrogen Technical
5 Director at Air Liquid Advanced Technologies in Houston,
6 Texas.

7 He's also served on many codes and standards
8 development committees and is a member of the USDOE
9 Hydrogen Safety Panel.

10 And I can say, personally I've have the pleasure
11 of serving on the Fuel Cell Partnership Working Group
12 with Aaron for many years.

13 And I've got to get used to your new hat and
14 affiliation here, so Aaron.

15 MR. HARRIS: Thank you, Jim.

16 So, I'm looking forward to running through a
17 slides that I think give you the perspective, based on
18 the questions you asked.

19 But I want to begin with what may be some
20 questions regarding -- you'll see our motto "Creative
21 Oxygen", and you might wonder, well, how does that play
22 into hydrogen?

23 And in fact, when you consider, and this has
24 actually been a bit part of Air Liquid's global
25 strategy, creative oxygen involves making sure that we

1 have clean oxygen to breathe and, therefore, reducing
2 the carbon emissions.

3 And so that's key to this aspect of what we see
4 as an enterprise moving forward and why hydrogen fits
5 very well into Air Liquid's global strategy.

6 So, speaking of that I wanted to at least begin
7 with the large big picture and I think one of the things
8 that I think sometimes challenges some of the
9 corporations in this space is that we aren't motivated
10 to participate, necessarily.

11 And I think that that is not necessarily the
12 truth. What I wanted to make sure that I articulated is
13 that we do see a huge opportunity in this market,
14 globally.

15 And if you look here, this is a quote from Air
16 Liquide's Global CEO, "If 10 percent of the global fleet
17 of cars could represent \$138 billion sales revenue"
18 which is twice the size of the global industrial gas
19 market today.

20 So, obviously, for us, there's a strong
21 motivation to understand, learn and develop in this
22 area. And certainly, the activities in California
23 present an opportunity to learn alongside the State.

24 So, you had asked about some of the network
25 planning, what's going on as a network? And I'll try to

1 drill down slowing into what's going on.

2 So, starting at the global level, Air Liquide
3 has developed quite a bit of experience in putting
4 fueling stations in the ground, understanding this
5 technology, coming up with designs, 60 stations total.

6 And are now participating with -- you know,
7 globally in these three regions with these very
8 substantial efforts. Not only the 100 stations that are
9 identified here in California, but also other regional
10 activities, as was mentioned earlier, throughout the
11 U.S. and throughout the Americas in general.

12 Then looking in Europe, we've got quite a bit of
13 activity in Germany, but not only just Germany, but
14 Scandinavia, the UK, France, all throughout Europe as
15 well.

16 And then Japan, there's been some recent
17 announcements within Japan and its plans for putting 100
18 stations in.

19 And so I think when you look at that activity
20 globally for us there's obviously a lot to be gained.

21 But one of the things I wanted to make sure I
22 highlighted here, and although you asked me for some of
23 the information about the European experience and I'll
24 look to make sure I talk about that in a few slides, I
25 wanted to highlight what I think is important regarding

1 what California represents.

2 California is leading in several key areas of
3 technology. One of these, in particular, is the retail
4 sales, and with activity within weights and measures,
5 and trying to drive the technology from meters.

6 That has not necessarily been the case globally.
7 These other early-adopter nations and states have
8 decided to forego that in their planning, where
9 California's stepped out by itself, almost, and is
10 addressing this metering issue.

11 I think that's not only commendable, also maybe,
12 you know to Jim's point, it might be a little bit
13 frustrating. But I think frustration comes with being
14 the one who's in front and taking that lead.

15 So as long as you're willing to face that
16 frustration, I think that is certainly something that
17 we're interested in learning along with you.

18 So, that's certainly something that plays well
19 with us as far as internally, when we advocate for why
20 is California so critical when a global corporation is
21 identifying how to balance our activities, we can
22 identify certain lead activities within the State of
23 California and why the participation here is so critical
24 for us.

25 And that's what I've tried to highlight here, as

1 well, that we've identified and seen the sustained
2 government funding. And we don't think that there's
3 going to be a change, you know, necessarily coming
4 there.

5 That we do see California evolving as this
6 regional and national model, and so learning the lessons
7 as well as being a participant here is critically
8 important.

9 And then the leveraging of the experiences and
10 opportunities, as Anthony had alluded to earlier, across
11 the U.S. and being able to identify that. You know, in
12 a sense trying to opportunistically say that this now is
13 the time to jump into that.

14 So, stepping yet another level down and deeper
15 into the details, we do see this -- as Brenda was
16 pointing out, this transitional effect. And in fact, it
17 is one of our core tenets within our program for
18 hydrogen energy is to produce, by 2020, 50 percent of
19 the hydrogen through carbon-free processes.

20 And so that certainly aligns with the activities
21 within the State of California and it aligns with our
22 global initiatives, and our goals, and the way that we
23 see this market evolving.

24 So, I think that's very critical in my mind that
25 you'll see this industry-to-government collaborative

1 initiative because we see that. And I think that's not
2 necessarily the result of just a benevolent corporation.
3 That's certainly shareholder input. That's certainly
4 driven from you know, market forces that are controlling
5 or pushing us in that direction.

6 But I do want to make sure I highlight the fact
7 that I've pointed out, and as Brendan pointed out, there
8 is a transitional effect between natural gas, natural
9 gas with carbon capture, biomass, and biogas, all the
10 way to solar and wind.

11 And so, to simply state that if we were going to
12 try to jump over this entire technology and go entirely
13 to electrolysis from renewables, we would be missing
14 several of the key opportunities that we have.

15 And as I think Anthony's models showed, that
16 cumulative effect of carbon reduction could be greatly
17 affected if we try to just drive to that one end.

18 And so, I wanted to make sure that I articulated
19 that, as well, since we see that as an opportunity from
20 the various types of source feedstocks to our hydrogen,
21 and that's critical that we can develop all of those
22 alongside the program.

23 Another aspect of this is that we aren't,
24 necessarily, simply just interested in the light duty
25 vehicle aspects of this. Certainly, there's aspects

1 within the forklift market, in the bus market, our heavy
2 duty market, medium duty market.

3 And I think we have experience in all of those,
4 in all of our sectors. But it's certainly something
5 that I think is helping.

6 In particular, one of the things that, having
7 spoken with my European colleagues, the primary concern
8 in a lot of ways is this social acceptance, the societal
9 acceptances of hydrogen as a fuel.

10 And being able to locate it in various places
11 and not just pushing it through the light duty vehicles
12 really enables that and highlights that.

13 I think the bus programs that you see within the
14 State of California are critical to that and I wanted to
15 make sure I highlighted that, as well, because we see
16 that with all of our global sectors.

17 So, to speak, as I had promised, a little bit
18 about the European experience, I think it's important to
19 note that with Germany there is, I would say, a
20 substantial amount of effort. And we can compare the
21 actual overall spend plans and the ambitions of the
22 goals.

23 But I think what's a layer below that is that
24 first bullet point where I'm pointing out, in a sense,
25 there's a little bit different approach within this

1 German way of moving forward. And that is, in a sense,
2 taking this private/public partnership and moving that
3 forward.

4 And I think trying to make sure it was an
5 objective together to put these in and not necessarily,
6 I would call more our California experience sort of a
7 call-and-response. There's a proposal and there's
8 responses.

9 But I think that we've seen a lot of challenges
10 to that. I don't want to say one is better than
11 another. I certainly think that there are challenges
12 here, but I certainly think if we don't understand that
13 distinction between the two, then we would be comparing
14 apples to oranges when we make comparisons, say, between
15 Germany and California in saying what we're doing.

16 As I pointed out earlier, there are some things
17 that we're leading in here. I think there certainly are
18 going to be some things that they may accelerate in the
19 market with on this plan.

20 And how that evolves and making sure that we're
21 coordinated I think will be a good -- you know,
22 something that we'd be excited about participating with.
23 I think we can lend insight from participating in these
24 various sectors.

25 So, another question that you had for us in our

1 panel was this idea of technology versus scale. And I
2 tried as simply as I could to kind of quantify this in a
3 description that I think is clearly attributable to what
4 we think is really going to drive this market, and
5 that's what somebody's going to pay at the pump.

6 And the truth of the matter is that I think the
7 way the question was worded by answer is very
8 specifically yes.

9 So, I tried to make it a little bit more
10 explanative than that and saying that I know there are
11 technologies today, they're either in a lab, they're in
12 early phases. They are not necessarily something that I
13 can go and put into a station tomorrow within the State
14 of California.

15 And the challenge that I face is that I then
16 have to identify the right one, go and demonstrate it
17 for myself, ensure that I'm confident about its
18 performance and then implement it.

19 And anything we can do that accelerates that
20 portion of technology development, not necessarily going
21 and pushing money into, you know, new, brand-new
22 technologies, but these are new and emerging
23 technologies and they're there. And they could create
24 this opportunity that I'm showing here.

25 You know, where that negative portion of this,

1 while we're keeping this sort of cost price range at the
2 same place for that end user, that negative portion is
3 what we see as a subsidy.

4 And, you know, we have to be able to have line
5 of sight to eliminate that subsidy over the course of
6 time such that these costs can come in.

7 And that's why I say demonstration and
8 validation of those technologies that are just over the
9 horizon for being commercial, pre-commercial.

10 And I've identified a couple here. And I would
11 make sure that I incorporate the fact that there's
12 business processes to that. It's not just some new
13 widget or device that helps. It's also can we validate
14 a business process that we think might be evolutionary
15 to this.

16 And then, finally, I wanted to highlight the
17 fact that for a lot of the challenges that we face,
18 regulations, codes and standards are certainly one of
19 them. And it is in this area where technology
20 advancement challenges us probably the most as far as
21 investment -- private investment into this.

22 How we go about incorporating additional
23 resources to address not only the risks in permitting,
24 but understanding all of these details is where I think
25 we can certainly benefit either from a collective

1 approach, private/public partnership approach and those
2 sorts of things.

3 I highlight two here. One is this risk-based
4 and performance-based. This is getting a little bit
5 into the weeds of details on permitting.

6 The second is with regards to liquid hydrogen
7 and bulk storage. If we're talking about centralized
8 systems of dispensing hydrogen at large quantities,
9 similar -- you know, approaching the quantities and
10 number of fueling events for a typical gas station, then
11 we are talking about systems that have this bulk
12 capacity. And liquid certainly is one of those options.

13 And I think that being able to identify that as
14 a high priority -- I know the DOE already has identified
15 this one and so I bring it up here to reemphasize that
16 as well.

17 I think that's the last slide I have for you.
18 It is. Thank you.

19 COMMISSIONER SCOTT: I do have a couple
20 questions for you. Thank you for that terrific
21 presentation.

22 And one question, and maybe there's too many
23 lessons learned or stories to share right now, but I
24 appreciate and take your point on the German experience
25 versus the U.S. -- or the California experience.

1 And, you know, if there were certain pros or
2 cons to one or the other that you would want to
3 highlight for us here, now?

4 Of it not, if that's information that you could
5 share with us in additional detail, I think that would
6 be terrific.

7 MR. HARRIS: Yeah, absolutely. I mean, I
8 think -- so, I have to speak for myself and being with
9 the Americas, technical lead.

10 And so, I have a certain bend toward our
11 approach in the Americas. But certainly in conjunction
12 with my colleagues overseas I can better refine that and
13 answer questions moving forward.

14 COMMISSIONER SCOTT: Sure.

15 MR. HARRIS: And like I said, I think they're
16 just different is probably the best way to put it. And
17 understanding those differences will be, I think in a
18 sense, critical to you in planning.

19 COMMISSIONER SCOTT: Yeah, absolutely. Thank
20 you for that.

21 And my other question for you, I think it was
22 terrific to hear that you're committed to producing at
23 least 50 percent from carbon-free processes.

24 Do you have a pathway towards that or what level
25 are you at, now?

1 MR. HARRIS: That's a good question. I can't
2 answer that immediately with a number, but yes. And I
3 would say that what you saw there as far as
4 technologies, carbon capture for natural gas in
5 reforming systems, and then biogas and biomass are
6 certainly the next evolutionary steps for us.

7 But that's not to say -- a good majority of the
8 stations that are being developed in Germany are
9 electrolysis based.

10 So, globally, we're probably all along that
11 pathway. You know, targeting in, say, California
12 probably not quite as heavy into the renewable side.
13 But that's not to say that there aren't folks who are
14 using that technology, it's just not something for us,
15 for the Americas that is necessarily as keyed into.

16 But like I said, it's how are we going to learn
17 from our German experience and we can translate very
18 easily and very readily to California, as needed.

19 COMMISSIONER SCOTT: Great, thank you.

20 MR. MC KINNEY: And Commissioner, can I follow
21 up on that question, please?

22 So, Aaron, when you talk about electrolysis in
23 Germany is that central station or is that on site?

24 MR. HARRIS: I think it's a mix -- it's actually
25 on site, as far as I understand it, with a mix of both.

1 I know there are several large demonstrations of power
2 to gas going on in Germany, so that's certainly one of
3 those things that I think has been highlighted already,
4 this potential for hydrogen storage.

5 It's just important to I think note that where
6 the world is going to look to California for metering
7 technology, California's going to need to look to other
8 folks to find out what their demonstration has done. I
9 don't think there's need to, necessarily, replicate
10 immediately. You know, we can learn when we need to
11 learn.

12 That's probably my advice, in a sense.

13 MR. MC KINNEY: Great, thank you very much, Mr.
14 Harris.

15 Our next speaker is Daniel Dedrick from Sandia
16 National Laboratories.

17 Daniel manages the Hydrogen Combustion
18 Technologies Group at Sandia and is responsible for a
19 broad range of applied research programs and energy
20 systems.

21 He's a mechanical engineer from the University
22 of California at Berkeley. I just have to -- as a
23 Berkeley alum, I'm very pleased to see a fellow alum on
24 the panel throughout today.

25 Daniel has expertise in heat transfer, mass

1 transfer and energy systems design, in addition to
2 organizational leadership and strategic planning.

3 Daniel leads Sandia's Hydrogen and Fuel Cell
4 Technologies Program which provides leadership in
5 critical RD&D areas, including high-pressure hydrogen
6 systems, hydrogen safety, codes and standards, renewable
7 hydrogen production, hydrogen effects and materials,
8 advanced hydrogen storage and fuel cells.

9 Daniel is known for developing meaningful
10 partnerships with industry, labs and academia to
11 accelerate the deployment of clean energy technologies.

12 He is the author of many peer review
13 publications in the areas of renewable fuels and
14 hydrogen energy.

15 Welcome Daniel.

16 MR. DEDRICK: Thank you, Jim and good morning,
17 Commissioner.

18 So, as Jim indicated, I'm from Sandia National
19 Labs just down the road in Livermore, California. We're
20 located very close to the Bay Area for strategic
21 purposes. And if you ever have a chance of visiting us,
22 please let me know, I'd more than welcome you to come
23 visit us.

24 I'm happy to be here today and be able to
25 participate on this panel. It's an outstanding panel

1 with a very important topic and so I'm glad for the
2 invitation. Thank you for that, Jim and Commissioner.

3 For me this is an extremely exciting time to be
4 involved in hydrogen fuel cells. I've been involved for
5 almost a decade, a little over.

6 And it's very rare that you get to see the
7 introduction of a whole brand-new vehicle platform and
8 the infrastructure system to support that. So, it's
9 very exciting to participate in that and I couldn't be
10 happier.

11 So, a little background on Sandia; Sandia is the
12 DOE National Lab. It happens to be the U.S.'s largest
13 national lab and we have responsibilities in the areas
14 ranging from national security to energy security, and
15 we work in both stationary and transportation energy
16 applications.

17 Our programs in hydrogen fuel cell technologies
18 are supported by the DOE, the Fuel Cell Technologies
19 Office, in addition to support from state and regional
20 government agencies, and private sector partners,
21 including the car companies and the technology companies
22 associated with hydrogen fuel cells.

23 So, our goal as a national lab is to work with
24 the private sector to accelerate clean energy
25 technologies into the marketplace.

1 And we have a history of doing this. And
2 because of that track record, the DOE has asked Sandia
3 and our sister laboratory, the National Renewable Energy
4 Laboratory to provide some leadership in the area of
5 hydrogen infrastructure.

6 And what they've asked us to do is to look at
7 ways that we can advance hydrogen fueling
8 infrastructure, accelerate innovation and help reduce
9 the cost of hydrogen infrastructure. So, I'll talk a
10 little bit more about that today.

11 Can I have the next slide, please? So, the
12 State of California, through investments from the CEC,
13 in partnership with the Air Resources Board, is
14 providing internationally recognized leadership.

15 And I think this is something that Aaron pointed
16 to in his presentation. And this is a true statement.
17 I think around the world, whether you're in Asia, where
18 there's a lot of activities are in Japan, or in the EU
19 and Germany there's a lot of focus on California and how
20 things are going here. And so, there's a lot of
21 leadership that California provides.

22 And so, it's very impactful, the work that's
23 being done here.

24 And so, through the work of the California Fuel
25 Cell Partnership we now know the roadmap to achieve the

1 full market potential of hydrogen fuel cell vehicles.

2 And now, we have the challenge of reaching that.

3 So, the State investments in general are really
4 enabling the car companies, such as Toyota, to get the
5 long-range, high-performance vehicles on the road. And
6 without these investments, these cars could not be sold
7 and leased in the State of California, of course, so
8 this is very important.

9 So, the transition to zero emission vehicles is
10 not easy, of course, and it will require continued
11 policy support, persistence and strategic investment,
12 and technology innovation to build the fueling
13 infrastructure network.

14 And this will lead to reduce station costs,
15 improved reliability and then, ultimately happy
16 customers behind the wheels of cars.

17 And so, I think one important thing to point out
18 here is remember the high-pressure hydrogen systems are
19 a successful commercial technology. It's just that this
20 is a new retail application for that successful
21 commercial technology. And we need to be working
22 together to make sure that it's successful in that new
23 environment.

24 So, as with deploying any new technology
25 platform challenges will be faced in terms of cost,

1 which the CEC is experiencing now, of course.

2 Also, you know, customer experience is very
3 important and those challenges need to be addressed.
4 Those perceptions of the early customers, as these
5 vehicles get on the road, as they start using the
6 fueling stations those -- those are going to be
7 challenges, as with any new technology introduction.

8 The next slide, please? So, the most obvious
9 challenge right now is cost and this is the whole point
10 of this panel, of course.

11 And the cost is really associated with the
12 refueling station hardware and systems. And so, if you
13 look at a hydrogen fueling station, as one shown there
14 on the slide, it looks very similar to a gasoline
15 station, yet the cost is much more.

16 And, you know, this is something that's going to
17 be seen by the investments by the CEC, hydrogen fueling
18 stations can cost between, say, \$1.5 and \$3 million
19 which, you know, is something that if you compare this
20 to a conventional hydrogen station or a conventional
21 gasoline station, which has had, you know, a hundred
22 years of innovation and government subsidy behind it,
23 we're looking at a five to seven times cost premium for
24 the hydrogen fueling systems.

25 And the hydrogen fueling system cost really

1 comes from the storage, compression and the dispensing
2 components within these systems and these are causing
3 the cost premium.

4 There are other things like conservative design
5 approaches, which also impact cost of these stations.

6 So, we may not need to achieve cost parity with
7 gasoline stations in the next five to ten years, but we
8 do need to start showing a pathway to driving down the
9 costs and making progress towards cost similarity with
10 the more conventional fueling stations out there.

11 And so, making progress on that pathway is, of
12 course, very important.

13 The next slide, please? So, the total cost of
14 hydrogen fueling stations is influenced by three main
15 factors, the level of experience with the technology,
16 the economies of scale that are in the current market
17 environment, and the cost of the technology, the
18 compression, storage and delivery technology.

19 The two first cost factors, which are a lack of
20 experience and economies of scale, these are almost
21 entirely functions of the market. Meaning as the demand
22 grows and we get more and more stations in the ground,
23 costs will naturally be reduced.

24 However, this approach will not allow us to
25 reduce the hydrogen fueling station cost sufficiently

1 enough to achieve full market potential because we
2 haven't addressed the cost of the technology, yet.

3 So, a subsidy-based strategy for initial station
4 capital costs and operation will be effective as long as
5 the strategy has longevity, of course, and it is
6 coordinated with a focused effort in technology
7 innovation to reduce the compression storage and
8 dispensing technology capital cost.

9 So, this coordinated approach that includes
10 early market subsidies and technology innovation support
11 will help achieve the ultimate cost targets and drive
12 down the cost of hydrogen stations to a level that can
13 be accommodated in the open market by private investors.

14 So, to help accelerate hydrogen station
15 innovation and drive down costs and also, of course,
16 encourage a positive customer experience with the
17 fueling network Sandia and the National Renewable Energy
18 Laboratory are -- have formed a partnership to help
19 accelerate these technologies.

20 And this effort is in support of H2USA. Some of
21 you may be familiar with H2USA. It's the National
22 Public/Private Partnership focused on accelerating
23 deployment of hydrogen fueling stations. And it
24 currently consists of over 30 major private sector
25 partners from the auto companies, station providers,

1 government agencies, and associated stakeholders.

2 So, to this effort, Sandia and NREL will be
3 contributing their foundational expertise, their
4 experience, specialized facilities and, of course,
5 technical objectivity and work directly with the private
6 sector to incubate and prove new technologies, and
7 accelerate them into the market.

8 The next slide, please? So, in order to be most
9 impactful with our collaborate efforts, the Sandia and
10 NREL team are forming partnerships with leading private
11 sector organizations. And we're actually forming
12 project teams with these organizations to address some
13 of the biggest opportunities for cost reductions and
14 performance improvement.

15 And we're actually in the process of formalizing
16 what we call a Stakeholder Review Board, consisting of
17 many of these organizations you see on this slide here
18 that will help us identify and prioritize activities
19 that we work in.

20 The next slide, please? So, using input from
21 our partners, Sandia and the NREL team developed a 10-
22 year roadmap and we actually published this roadmap.

23 And this identifies technical areas that need to
24 be addressed to reduce station cost and enhance the
25 customer experience associated with hydrogen refueling

1 infrastructure.

2 And so, just pulling out a few examples, there
3 are a number of near-term high impact opportunities
4 requiring collaborative approach.

5 And I'm highlighting those here, on the right-
6 hand part of this slide. And we're actually forming
7 project teams around these areas to advance our efforts.

8 And just as an example, some of these near-term
9 areas include reducing the station footprint by
10 developing a better understanding of the risk and
11 hydrogen release scenarios.

12 And what this does is this enables a larger
13 number of stations to be deployed on smaller plots of
14 land.

15 And so, there is almost 10,000 refueling
16 stations in the State of California. Of those, about
17 347 fall within the CEC's -- or the priority areas as
18 identified by the PON.

19 And so you can see that we're going to need to
20 be able to install stations in those 347 some station
21 areas. And looking at being able to reduce footprint is
22 going to be extremely important.

23 So, another area is enhancing reliability of
24 components. And this would be by developing an
25 understanding of failure modes and working with the

1 private sector to enhance reliability. This reduces
2 operating costs so that you don't have to spend so much
3 money keeping your station running. It also improves
4 your customer interaction.

5 Third, developing and implementing methods for
6 evaluating hydrogen dispenser performance and making
7 sure that the customer is getting what they pay for,
8 regardless of the station provider.

9 And finally, being able to eliminate unnecessary
10 high value materials from the system and this is a huge
11 lever in the development of these stations, and it has a
12 big impact on cost.

13 And if we can minimize the amount of these
14 materials, cost can be substantially reduced.

15 The next slide, please? So, to illustrate, and
16 I apologize for the business of this slide, but to
17 illustrate the scale of impacts that our efforts could
18 have on station cost, we can consider the approach of
19 selecting alternative materials for the high pressure
20 components within the compression storage and dispensing
21 system.

22 So, what I want you to do is consider a simple
23 tube containing hydrogen at pressure, which represents
24 the basic characteristics of many pipes and components
25 within the hydrogen station. It's an over-

1 simplification, I admit, but it's good for this
2 exercise.

3 And the two wall thickness required to contain
4 the hydrogen air pressure is readily calculated and,
5 thus, the amount of material that is needed to actually
6 do that using formulas found in well-established design
7 codes.

8 And so, a particular stainless steel for this
9 example called 316L is commonly used in hydrogen
10 systems, and this includes hydrogen refueling stations.

11 And this alloy has many advantages, including
12 resistance to weakening in hydrogen service. In
13 addition to it having a very established track record,
14 so it gives a lot of confidence in its use.

15 Unfortunately, the main disadvantage is the high
16 cost due to a very high nickel content in this alloy
17 which drives up the cost of the material itself and,
18 thus the system.

19 So, 316L's high cost, coupled with its
20 characteristically low strength or relatively low
21 strength compared to other allows means that current
22 fueling systems are relatively costly.

23 And in the example analysis shown here, we can
24 calculate cost on a relative scale, and that's the red
25 box that's circled there on the slide.

1 And if we calculate the cost of this component
2 on that relative scale, we can give the cost value of
3 316L a value of one, so that's our baseline cost.

4 So, anything higher than one is higher cost and
5 anything lower than one is lower cost.

6 So now if we start thinking about alternative
7 materials that are lower cost and/or have higher
8 strength to replace that 316L, you can see that cost
9 reductions upwards of 70 percent are achievable. And
10 this is on, of course, the component level.

11 And so, you can see a very strong motivation to
12 start thinking about alternative materials in these
13 systems and it also provides some hope for dramatic cost
14 reductions in the capital cost of these systems.

15 So, you might ask why are these materials not
16 commonly used today and that's a good question.

17 And, quite simply, there is insufficient
18 materials properties data and experience with these
19 materials especially, of course, in the retail fuel
20 environment to encourage their widespread use, and this
21 is something that we can address.

22 So, this is a perfect example of how we, in the
23 research community, can work directly with the private
24 sector to develop new, low-cost, high performance
25 hydrogen fueling systems which then can ultimately reach

1 the ultimate cost targets.

2 So, in conclusion, fuel cell electric vehicles
3 of course are, and I think we all very much understand
4 this, but a vital part of a secure and sustainable
5 energy future.

6 And they are critical to the success of
7 California's clean air and environment program goals.

8 Policies, such as the ZEV credit system and
9 station cost subsidies, are being implemented to
10 accelerate this future.

11 And the truth is that fuel cell electric
12 vehicles will only be successful if we develop a
13 comprehensive strategy to transition the hydrogen fuel
14 station investment burden from the State agencies to the
15 private sector. And it's really going to require
16 addressing all of those three cost areas that I talked
17 about.

18 So while economies of scale and experience will
19 help reduce cost, a major part of this transition
20 strategy needs to relay on advancing innovative, next-
21 generation technologies into the market through
22 public/private partnerships and thus reducing station
23 cost and, ultimately, leading to happy drivers behind
24 the wheel of vehicles.

25 So, there's a real opportunity here for the

1 state, federal and private sector stakeholders to work
2 together to reduce hydrogen station costs. And, really,
3 this would be paving the way for improved air quality,
4 of course, and a healthy economy.

5 And I'm confident that we can be successful. We
6 have the community to be successful in this because the
7 stakeholders are engaged, as evidenced by this workshop
8 and many other events, even on the national level.

9 So, thank you and please come visit us on our
10 open campus, which I show a picture of here.

11 MR. MC KINNEY: Great, thank you very much,
12 Daniel that was very, very informative.

13 MR. DEDRICK: Thank you.

14 COMMISSIONER SCOTT: Right, that was incredibly
15 informative. The one question I had for you -- I
16 actually had a bunch of questions but then you kept
17 answering them as you went along.

18 MR. DEDRICK: Oh, good.

19 COMMISSIONER SCOTT: And I look forward to
20 having happy drivers, as well.

21 Is the timeline that you see for some of these
22 material advancements and does that kind of fit along
23 with the timelines of when we see the introduction of
24 the cars, or the timelines for -- as the stations are
25 getting built, and the kind of next-end stations.

1 MR. DEDRICK: Yeah, I think that's a very
2 important question. And I think there's -- and if you
3 look through kind of our white paper you'll start seeing
4 some of these. But there's very near-term, low-hanging
5 fruit which we could probably focus on.

6 And then there's much longer term, like five,
7 ten years sort of things that we need to start working
8 on today to make sure that in ten years the State of
9 California is fully out of the business of subsidizing
10 hydrogen stations. So, there's a little of both.

11 You know, an example of a near-term thing that
12 could be done is some of these components on the
13 station, like the nozzle, are incredibly expensive,
14 thousands of dollars. And from a scientific perspective
15 there's no reason for that. But there's some things
16 that can be done there to reduce those costs in the near
17 term, which could be on those time scales.

18 Similarly, if you think about some of the costs
19 in bringing stations online, making sure that you can
20 get the stations online very quickly, there's ways that
21 we can accelerate that today.

22 So, being able to work with stakeholders to test
23 the stations appropriately meaning, you know, we can get
24 the fuel into the hands of consumers in weeks, instead
25 of months, or maybe even days or less.

1 So, there's definitely some near-term
2 opportunities.

3 COMMISSIONER SCOTT: Thank you.

4 MR. MC KINNEY: Great, I'd like to introduce our
5 next speaker. So, we'll have Matt McClory from the
6 Toyota Motor Corporation.

7 Matt McClory is a Manager with Toyota's
8 Technical Center's Power Train System Control Department
9 in Torrance, California.

10 His primary responsibilities include the
11 development, testing and evaluation of prototype fuel
12 cell vehicles, as well as coordinating Toyota's
13 contributions to the SAE Fuel Cell Vehicle Safety Codes
14 and Standards Working Groups.

15 In addition, he is involved in activities
16 supporting development of the hydrogen refueling
17 infrastructure and external affairs promoting Toyota's
18 message for sustainable mobility.

19 Mr. McClory earned a Bachelor of Science Degree
20 in Mechanical Engineering from UC Davis.

21 And I'd just like to say by way of further
22 introduction that it's just been a tremendous experience
23 to see what these major corporations, so Toyota, Honda
24 and Hyundai, really, I think, have the first set of
25 announcements for vehicles to be available this year and

1 next model year. It's just tremendously exciting and
2 I've been able to drive some of the vehicles, as has
3 Commissioner Scott, and we're just incredibly pleased
4 with the innovation that Toyota's bringing to this
5 field; so Matt.

6 MR. MC CLORY: Thank you for that introduction.
7 Good morning and, first of all, I'd like to thank
8 Commissioner Scott and the CEC staff for putting
9 together this workshop. I think so far the
10 presentations have been very interesting and I have a
11 lot of information to take back to my group.

12 Unfortunately, I was a bit late in submitting
13 it, so hardcopies, I think, are not available for this
14 morning, but I think that's something that is possible.
15 So, I'll just talk to the slides that we have today.

16 The next slide, so the kind of one-slide summary
17 of what my company does is we make a focus right now
18 towards sustainable transportation technologies for
19 vehicles that range from very small vehicles, such as
20 scooters. There's actually an urban mobility concept
21 that was introduced called the i-REAL, at Las Vegas, at
22 the CES, and is going to start having trials in Japan
23 and the U.S. And it's a way towards trying to reduce,
24 again, carbon and pollution within urban environments.

25 This chart, I apologize, it has a lot of

1 different pieces of information on it, but what it's
2 intending to show on the horizontal axis is basically
3 energy sources from electricity through conventional
4 fuels, biofuels, CNG, synthetic fuels towards a spectrum
5 resulting in hydrogen on the right-hand side.

6 And this correlates with vehicle size. And some
7 of the key areas I'd like to highlight very simply here
8 is that towards a zero emission portfolio of vehicles we
9 see that electrical vehicles and fuel cell vehicles both
10 can exist in a complementary fashion towards those
11 goals.

12 And I think one of the key things that was
13 highlighted earlier is that the fuel feedstock needs to
14 also follow along in development towards a sustainable
15 zero greenhouse gas, as well as zero pollution from that
16 perspective.

17 But also, one of the key things here is that in
18 the near term, as we look at reduction and reduced
19 emissions we do look at plug-in hybrid vehicles. And we
20 see plug-in hybrid vehicles having an opportunity to
21 become kind of the dominant hybrid vehicle platform.

22 But one of the key things in that area is, of
23 course, a reduction in cost of the battery technology.

24 I'd also like to highlight that we see fuel cell
25 vehicles as being able to provide a wide range, not just

1 for light duty vehicle power trains, but also for heavy
2 duty vehicle power trains.

3 And currently, in the Japanese market we have a
4 fuel cell bus that's -- I believe it's on its fourth
5 generation and there are continuing activities for new
6 heavy-duty applications, both for buses as well as for
7 delivery trucks.

8 And so, we're very excited, actually, to be able
9 to see the potential of trying to bring that technology
10 to North America.

11 The next slide, so kind of getting into the
12 topic for this slot is looking at the hydrogen
13 infrastructure. And, fundamentally, we see that the
14 integrated and reliable hydrogen fueling network is a
15 prerequisite for being able to launch a fuel cell
16 vehicle market in larger numbers.

17 This picture is of the Shell Torrance fueling
18 station. It's, I believe, the only station that's in
19 North American that's both multiple dispensers and
20 pipeline-fed gas from a local methane plan, which uses a
21 renewable content to offset the production from natural
22 gas.

23 And one of the key things, one of the key
24 lessons from this is that the limited, the currently
25 limited seven-station network of 70MP stations in the

1 L.A. region have demonstrated with the fleet of vehicles
2 from multiple OEMs that an increase in the network will
3 bring more vehicles.

4 And the limitation of being able to deploy more
5 vehicles is limited by the network that exists today. I
6 think we all kind of understood this or guessed this,
7 but we have actually data, and I think the OEMs have
8 data in aggregate that demonstrates this key point.

9 The next slide, so to the first question
10 regarding automakers, what do the automakers need from a
11 hydrogen station network in California?

12 And speaking on behalf of Toyota, again I'll
13 reiterate that an integrated and reliable network is
14 critical to be able to pull retail market vehicle sales
15 and to be able to grow the market.

16 And the key takeaway here is that being able to
17 grow the market correspondingly allows you to increase
18 the rate of station utilization towards and economic
19 viable station operation, which is key. It goes kind of
20 hand-in-hand with being able to grow the vehicles.

21 Key elements of this network and I apologize for
22 the level of detail. I've tried to speak at a high
23 level here as a summary, but the key point is 100 retail
24 stations are needed.

25 This is part of the roadmap as well as, also, we

1 understand, the AB 8 objective.

2 However, I think one of the open items that
3 probably needs to be reviewed going forward is what the
4 actual target year is. The original target was 2017.

5 I would probably argue that 2019 should really
6 be the challenge target to be able to have enough of a
7 network in place to launch multiple OEMs into that space
8 within California.

9 Right now we're looking at, based on our count
10 of retail access stations in the public domain at the
11 right level is about 20 stations by the end of 2015.
12 And this, you know, is based on the 17 stations that are
13 funded by the CEC, as well as the upgrades that were
14 also funded through the CEC by the Air Quality
15 Management District.

16 And so we're very excited and we're following
17 very closely the progress of those stations.

18 I think the other thing also to highlight is
19 that the progress towards 100 retail stations is also
20 something that Toyota looks at very closely as we review
21 with our management the justification to be able to
22 bring larger volumes of vehicles for the market.

23 I think there's a phrase that says it's a very
24 iterative approach or it's definitely an approach that
25 needs to be coordinated, but progress towards those 100

1 stations is very important to the visibility within our
2 management to kind of justify the local market within
3 California as getting that portion of vehicles on a
4 global basis.

5 The second item is locations. The station
6 locations need to be coordinated and integrated with OEM
7 customer target markets. This is not just for Toyota,
8 but also for the OEMs.

9 And again, this kind of goes back to the prior
10 point, which it comes back to the utilization. In order
11 to have stations in areas, they need to make sure that
12 the utilization rate of those stations are meeting the
13 targets that are necessary to meet a cash flow positive
14 scenario at a future date so, the so-called cross-the-
15 valley-of death.

16 And so, having stations not only with the right
17 location, but also the right requirements are key to
18 this effort and I think moving together it's important
19 to coordinate that.

20 The third item is operational term of at least
21 ten years, with retrofit and scalability requirements.

22 The key thing here is that we're looking at
23 vehicle deployments over the long term and one of the
24 things that we're trying to transition from is
25 demonstration stations that were funded quite a few

1 years ago that are in the process of going offline, or
2 have uncertain futures.

3 And so, we need to make sure that stations that
4 are being funded today for retail access have a pathway
5 to be in operation for the long term.

6 Industry standard fuel interface is key; the key
7 takeaway here making sure that all automakers have the
8 same ability to access that station, it's not something
9 that's proprietary.

10 Then also the performance, both for daily fill
11 capacity and peak hourly capacity and basically the
12 details of this are you need to have a certain level of
13 performance in the early market days, but you need to be
14 able to be scalable within a certain timeframe to be
15 able to grow with the market. Otherwise, you know, you
16 basically have a stranded asset that is not able to
17 upgrade, then we're limited again in the growth of the
18 market.

19 The next slide, so a continuation on this
20 question and I think we've seen some progress on this,
21 is the first bullet is we're really excited about the
22 progress that the stakeholders and DMS has made to be
23 able to reach certification for retail point of sale.

24 This is a very key area and we're very excited
25 to see the progress that's here. And I that this has

1 kind of been said earlier by some other speakers that it
2 shows, also, a path forward for some of the markets in
3 Japan and Europe as a kind of a reference example.

4 And we're looking forward to having some of the
5 first stations receive certification by the end of this
6 year in that effort.

7 Also, don't want to lose sight of fuel quality.
8 This is a key area that we've had a lot of opportunities
9 of learning over the past year, where we're not only
10 meeting the fuel quality, but also making sure that
11 testing at the station is part of the integrative
12 process, so the way the station works similar to a
13 gasoline station is inherent and integrated into the
14 station.

15 Retail point of sale transactions or retail
16 access, this is a key area to highlight because this is
17 really one of the fundamental areas that we transitioned
18 from demonstration stations that are operating today
19 into retail stations that we are, you know, looking to
20 come online by the end of this year.

21 That will be really a groundbreaking event that
22 it will be the first time within North America that we
23 would have the capability to have a truly public and
24 retail station that emulates a gasoline fueling
25 experience for the customer today.

1 Also, as was mentioned earlier, reliable, high-
2 availability design and operations, basically, we're
3 really excited about the efforts of Sandia and NREL, and
4 with the H2First activity to kind of focus in this area,
5 as well as other folks, or other groups working in this
6 area of high availability, looking at requirements to
7 make sure that the stations stay online for the
8 customer.

9 And then another area that I think is going to
10 be interesting to look at for this year, we'll be
11 looking at hydrogen dispensers that are not co-located
12 at existing gasoline stations.

13 This is, of course, an area that was an issued,
14 currently today. But as was mentioned, the amount of
15 gasoline stations that are available to fit hydrogen
16 dispensers within target markets are very limited and
17 then you also reduce the number of those with the
18 retailers that actually want to participate.

19 And so, the ability to be able to install
20 dispensers at, in a sense, green field sites, or non-
21 gasoline sites are really key to growing the market in
22 California.

23 And one of the key areas is looking at
24 simplifying the CEQA process in a way that it is done
25 today with gasoline sites.

1 And finally, the last item on this part is the
2 engagement of fuel retailers as key stakeholders. I
3 think we're starting to see a transition to this. But
4 we definitely, as we go towards a larger market, we want
5 to see more of an involvement with the companies and
6 coalitions that are going to be key to this field as the
7 retailer in the future market.

8 MR. MC KINNEY: And Matt, just a friendly time
9 check, you've got about three minutes left.

10 MR. MC CLORY: Uh-hum, my next slide. So, I
11 think this was the second question and I can just
12 summarize this: How can automakers support development?

13 Basically, the key areas are communication and
14 coordination across the stakeholders.

15 Some of these, as I had mentioned before, is
16 reviewing locations across the OEMs as part of target
17 markets and utilization planning in these areas.

18 The second, as has been done I think in the past
19 several years, is the design requirements, communizing
20 those design requirements across the industry.

21 And feeding into this is the California Fuel
22 Cell Partnership. This acts as a data store for OEM
23 aggregate consensus information.

24 And in addition to that, there's also measures
25 that could be considered to basically ensure or provide

1 assurance measures that early market fuel demand will be
2 there for those operators.

3 The next slide, and I think what I'll do is I'll
4 end on this question here and then I'll leave the rest
5 for the backup.

6 What additional changes are needed on light duty
7 vehicle fuel cell technologies?

8 So, currently we have a vehicle that's shown
9 that we're planning to bring to market in the 2015
10 timeframe, that have reached the ability to reach
11 cruising ranges approximately 200 miles and fueling time
12 is three minutes, and cold start capability down to
13 minutes 30 degrees Celsius.

14 The remaining challenges are to be able to
15 continue cost reduction, work on improving the power
16 density of the system, and as well as fuel cell stack
17 durability.

18 So with that I can leave these for questions.

19 MR. MC KINNEY: Great, thank you very much,
20 Matt.

21 Commissioner Scott or Douglas?

22 COMMISSIONER SCOTT: Sure, I had -- it was more
23 of a thought, actually, as you were walking through your
24 answers to question one, on slides three and four, it
25 reminded me that we're working closely -- the Energy

1 Commission has worked to fund a zero emission vehicle
2 permitting director, who's sitting over at the GO-BIZ
3 (phonetic) office and is thinking diligently about a lot
4 of these questions.

5 And we've got a strong State commitment to this.
6 The Energy Commission is working with GO-BIZ, is working
7 closely with the Air Resources Board and others to
8 really help get this done.

9 And I was thinking about what Aaron Harris
10 presented about the amazing amount of capital that's --
11 that could be captured if there's additional hydrogen
12 fueling stations. And just hope that the auto
13 manufacturers, and the station providers, and the gas
14 providers are all kind of working hand-in-hand the same
15 way that the State agencies are to sort of help overcome
16 some of these challenges.

17 MR. MC KINNEY: Yeah, and I'd also really --
18 again, to follow on what you're saying, Commissioner
19 Scott, I mean Toyota's innovation and kind of stepping
20 out of the traditional OEM sphere into permitting
21 issues.

22 So, on Monday many of us will be down in
23 Torrance to participate in a workshop that Toyota's co-
24 hosting with the Governor's Office of Business
25 Development.

1 It's really unprecedented to have an automaker
2 step into the hydrogen station permitting sphere in an
3 effort to -- and, really, it's what we try to do with
4 our Community Readiness Grants or Regional Readiness
5 Grants, really prepare local permit review authorities
6 and decision makers for what does a hydrogen station
7 look like, what are the steps, what are the safety
8 issues and all the standards that need to be met.

9 And how to make that happen smoothly so all
10 these stations that we have in the pipeline can come
11 into service as quickly as possible, so I want to tip my
12 hat to that initiative.

13 COMMISSIONER SCOTT: Agreed, I second that
14 compliment. I look forward to -- I'll be done there on
15 Monday, as well, working with folks.

16 And I'll also mention that I also got to drive
17 the car when you brought it by the Energy Commission and
18 it was good fun.

19 And so, we're looking forward to continuing our
20 work to get these out on the road.

21 Thank you for your great presentation.

22 MR. MC CLORY: Thank you.

23 MR. MC KINNEY: Any other comments from the
24 dais?

25 Well, with that I'd like to thank our first

1 round of panelists. Thank you very much, gentlemen.

2 (Applause)

3 MS. RAITT: And we'll take a brief break to set
4 up for the next panel.

5 (Off the record)

6 COMMISSIONER SCOTT: Okay, welcome back
7 everybody. We're going to get going again. And we are
8 starting our second panel of the morning, which is on
9 Electric Vehicle Charging Network and the Alternative
10 and Renewable Fuel and Vehicle Technology Program's
11 Strategic Goals for California's Electric Charging
12 Network through 2023 and beyond.

13 So, I'll turn it over to Jim McKinney to get us
14 going.

15 MR. MC KINNEY: Great, thank you, Commissioner.

16 For our second panel we are going to talk about
17 electric charging infrastructure. And I reviewed some
18 of the policy goals in my introductory comments.

19 So, briefly, to support consumer acceptance of
20 the light duty electric vehicles and complement what
21 ARB's doing through CDRP; help achieve the Governor's
22 ZEV Mandate targets of supporting one million ZEVs by
23 2020 and 2.5 million by 2025.

24 And some of the key questions that we had for
25 this panel are do we have the fundamental technologies

1 that are need for a mass market EV charging system or
2 additional technology innovations needed?

3 Do we have the fundamental tools to create a
4 widespread consumer-friendly charging network or
5 additional business, technology or regulatory measures
6 needed?

7 How can ARFVTP funding be used to overcome
8 specific technology and market barriers?

9 And lastly, what role can electric drive
10 vehicles play in helping to meet California's climate
11 policy goals through 2023 and beyond?

12 So, we have five very distinguished speakers on
13 that panel, so that means we're going to have a little
14 less time than we had for the previous panel.

15 I'd like to ask you to limit your remarks to 12
16 minutes apiece.

17 And our first speaker is Mark Duvall from EPRI.
18 Mark is a Director of EPRI's Energy Utilization Research
19 Area, which includes electric transportation energy
20 efficiency, power quality, energy storage, customer
21 research and electrification; so Mark.

22 MR. DUVAL: Thank you. So, at once I apologize
23 for a paper copy of my presentation not being available.
24 But the positive aspect of that is that when I saw some
25 of the other presentations I realized I had a huge

1 redundancy. So, rather than steal everyone's thunder I
2 sort of rerouted and I'm going to focus primarily on
3 technology.

4 And speaking of technology and next. Well,
5 anyone who's familiar with me knows that we can
6 comfortably go past the ten-minute mark with one slide.

7 (Laughter)

8 MR. DUVAL: All right, thank you. So, I want
9 to make a few comments and they're certainly up for
10 discussion, even argument. Not during ten minutes, but
11 maybe later today.

12 But, you know, the PEV landscape in 2025 is one,
13 obviously, that the adoption meets or exceeds the ZEV
14 program targets.

15 I just got back from the Bloomberg New Energy
16 Forum and I spoke with some of their transportation
17 analysts and they gave a great presentation where, you
18 know, amazingly enough the gasoline consumption in
19 California is going to decrease according to their
20 results by 2020, a significant decrease, almost ten
21 percent, I think.

22 And one of the things I told me, and that's why
23 I always love financial analysts, they said, we used the
24 ZEV Program, the baseline as for electrification, but
25 we'll exceed that, I think. California will go past

1 that, won't they?

2 And I said, well, you know, sure, if the right
3 things happen it's always possible.

4 So, I mean, like we're going to see a
5 significant increase not only in consumer vehicles, but
6 fleet adoption. Fleet adoption is trailing a little bit
7 in the on-road, but I think we're going to see
8 significant electrification both in the on-road and the
9 non-road, ports, airports, goods, material movement,
10 especially driven by air quality needs within the major
11 air basis, particularly the South Coast.

12 We're going to see more platforms, so we're
13 going to see larger platforms. So, we might see
14 different vehicles with different charging requirements.

15 I expect to see charging power, while there's
16 always going to be a very, very strong role for level
17 one charging, we're also going to see folks push up
18 against the upper limits of power, charging power as
19 well.

20 So, an increase in range and electric
21 performance. So, PHEVs and EREVs with more range; BEVs
22 with more range. So, BEVs with more range are
23 interesting and you like them because they reduce the
24 need for public and workplace infrastructure. I mean
25 the need. That doesn't meant they will reduce the want

1 or the desire for it, but it can reduce the need. And
2 even 20 miles of additional real-world range can
3 substantially change the number of people who -- what we
4 would call replacement days where someone driving a
5 battery electric vehicle has to either replace it or has
6 to stop and charge.

7 So that does -- and that is worth tracking in
8 terms of understanding if the State is ahead, even or
9 behind in providing enough infrastructure in those
10 areas.

11 Obviously, we're going to see vastly increased
12 capabilities in vehicle connectivity and in methods of
13 power delivery. And they are today and are well-
14 outpacing our ideas of what to do with those
15 capabilities.

16 And then we'll also almost certainly see
17 superior total cost of ownership from owning PEVs.

18 And the next slide. Especially given that in
19 California today, the Nissan Leaf, a car that Nissan has
20 declared is profitable by some metric, has basically
21 accounted for the \$7,500 tax credit in terms of total
22 cost of ownership. So, that gap is real and it's only
23 going to keep improving on the side of the EV.

24 The next slide, so we have a little bit of a to-
25 do list on the technology side, the technology and

1 planning side.

2 First and foremost is elimination of the
3 residential infrastructure barrier to PEV ownership.
4 The charging pyramid has held the home is the first
5 place. It's not the only place, not the only place to
6 charge, but it's the first and we'll have to figure out
7 how to account for multi-unit dwellings, and tenant-
8 owned structures, and apartment complexes. All of that
9 stuff, we have to get rid of that, that can never be a
10 barrier to ownership.

11 We need flexible, scalable and I would add
12 interoperable public and workplace infrastructure to
13 scale. Build what we need, when we need, where it is
14 needed.

15 We have to lower costs all around. We were just
16 talking at the break that while we're seeing equipment
17 costs fall, if anything installation costs are going in
18 the opposite direction. And almost mystifyingly given
19 that the electric contractors, the folks responsible for
20 these installations are by and large gaining more and
21 more experience, especially in places like California
22 and they just really seem like they're going in the
23 wrong direction.

24 And we've got to both develop an understanding
25 of that and start to drive that back down through

1 various means.

2 You're going to see EVSEs that are increasingly
3 connected, but that's going to have to happen at
4 dramatically lower costs. Especially if you want to see
5 connectivity on the home residential side, we're really
6 going to have to look at ways we're connecting Smart
7 appliances and looking at utilizing existing residential
8 broadband connections and things like that.

9 But it's going to have to really be done at a
10 cost level that's not even seen today within non-network
11 infrastructure.

12 And then where I think we can integrate PEVs
13 into load management programs or complete what I
14 consider the first stepping stone on the VGI objectives
15 or the vision is if they are, in many cases treated --
16 they are not demand response.

17 And inside EPRI I've always resisted lumping
18 plug-in vehicles in with other demand response programs.
19 But if we're using the methods and techniques and
20 integrating them into the same programs where a utility
21 is looking at thermostatic control of a house for demand
22 response or load management is getting the EV and some
23 of the other devices at the same time, I think there's
24 dramatic implications for cost reduction, or cost
25 effectiveness which provides more value to the vehicle

1 owner.

2 So, when we see technology -- right now we see
3 technology primarily as a means to reduce costs, cost of
4 everything, cost of ownership, cost of providing the
5 State's infrastructure network.

6 And finally, I don't want to use the term
7 "safer", but we need a more robust and resilient
8 charging equipment, particularly with cord-and-plug
9 connected EVSEs.

10 So, we've identified potential weaknesses within
11 cord-and-plug connected 120 volt, level one equipment,
12 and those are all solvable problems. Many of them have
13 been identified already, they're all solvable.

14 A lot of it has to do with old equipment. Old
15 outlets don't work as well as new outlets. But I think
16 we really need to get a handle around that because
17 that's the majority of installations going forward.

18 The good news on installation cost is that in my
19 mind the single greatest breakthrough on installation
20 costs have been done -- we didn't have to do anything.
21 PEV owners did it themselves. They costed out the
22 intermediaries, the seamless services that were
23 recommended to them when they bought their vehicles.
24 Many of them said I'm just going to do level one at home
25 or I'm going to hire my electrician, I'm going to buy my

1 own equipment.

2 We've some companies emerge quite successfully
3 leveraging this supply chain. You know, I'm going to go
4 on the internet and buy what looks good, and looks like
5 a good deal, and it has value. I'm going to put it in
6 myself or I'm going to get electricians to put it in.

7 So, the homeowners have made really dramatic
8 cost reductions over what might be the tab if you went
9 into the dealership and got all that done for you.

10 So, we can make more strides here, but I think
11 we do need to pay attention to that.

12 The next slide, please, and the next. There are
13 many deterministic ways of understanding how much
14 infrastructure the State needs and where it needs to be.

15 Richard's going to talk about one today that I
16 think is really unique and important. We need to keep
17 doing that. We need to keep sharing data. We need to
18 keep making it possible to understand what's going on in
19 infrastructure utilization, installation.

20 You know, the State -- the CEC just awarded a
21 phenomenal number of really great infrastructure
22 projects. We felt ours was good, but I think the others
23 were good as well, too. This is a tremendous
24 opportunity to leverage, to understand, really, what is
25 the current state of affairs in terms of equipment,

1 installation costs, utilization. We need to just keep
2 working that.

3 That means that researchers from UC Davis need
4 to have access to it. Researchers from EPRI, Edison,
5 everyone needs to have -- we need to protect private
6 data, but we need to really figure out what's happening
7 here and how we can address each of these issues.

8 The next and the next, and then we also have to
9 migrate the State from a primarily metropolitan-based
10 infrastructure -- the next slide -- to a regional
11 distribution.

12 What we're showing here is no dissimilar to the
13 analysis that UC Davis has done around fast charging
14 infrastructure.

15 We need to figure out what we need to do here to
16 provide access throughout the State and what it has to
17 look like, and how it can be done at the highest value
18 and lowest cost.

19 The next slide. The more advanced end of
20 vehicle-to-grid; so it's here today and we have the
21 capability to do it. Vehicles are being built with the
22 production capability to do it.

23 How will it be used? There are a number of
24 things that we can do here. One of the gaps here is the
25 evolution of real durable, sustainable business models

1 that the folks who tend to be more on the vehicle
2 technology can understand, hey, if I build this type of
3 vehicle and it can do these things in interacting with
4 the grid what is the business case for that and, really,
5 the long-term business case?

6 You know, given that Beacon Flywheel, and
7 extremely smart, exceptionally smart and very advanced
8 technology company, part of their -- part of their
9 failure as a company stemmed from not fully
10 understanding the risks of the ISO market they were
11 participating in, which was the New York ISO, where they
12 saw a dramatic drop in revenue just due to market
13 forces.

14 So, without -- what's going to be necessary for
15 this to evolve are going to be markets, or programs, or
16 incentive programs that really draw an economic box
17 around these technologies that someone can build to, or
18 develop a program, or aggregate to.

19 And then figure out is this a stand-alone, is
20 this leveraged with other business models? We just
21 really need to figure that out.

22 And that's -- we don't see that here today.
23 There are pieces of it and we see hope for more.

24 The next slide. We talk a lot at EPRI about the
25 integrated grid. California utilities talk a lot about

1 grid modernization.

2 The technology's being applied here are going to
3 improve the PEV charging experience. One example is
4 that we believe that you can lower the cost, especially
5 of public and workplace networks that tend to have
6 multiple chargers. In many cases many, dozens or
7 hundreds of chargers on a single load center or a single
8 location.

9 We believe that we can find more efficient ways
10 of feeding those locations, connecting installations at
11 utility distribution voltages.

12 So, instead of building 480 volt or 208 three-
13 base installations for fast charging, let's connect fast
14 charging at 8 KV.

15 There's documented cost reductions in doing
16 that. We can handle the -- the one problem I haven't
17 promised to solve is the three different fast charging
18 technologies that are currently in play in California.
19 And I would not bet that we will solve those by 2020. I
20 think the problem will work itself out.

21 But in the meantime, I think there are
22 technology options that will allow us to put charging
23 heads that feed from single VC charging engines that can
24 serve multiple vehicles, maybe dozen vehicles at a time,
25 allocate power between them, help to manage demand

1 impacts, all of this which will manage costs.

2 So, the next slide and I think I'm done. And
3 thank you very much.

4 Richard?

5 MR. MC KINNEY: Thank you, Mark.

6 COMMISSIONER SCOTT: Wait before Richard starts
7 I have a question.

8 MR. LOWENTHAL: I'm more comfortable standing
9 up. I'm short enough as it is. It helps if I stand up.

10 COMMISSIONER SCOTT: Before Richard starts,
11 Mark, I did have one question for you on your slide 10,
12 as you were talking about it you mentioned that some of
13 the pieces of the vehicle-to-grid are here today and
14 there's a lot more that we need to work on.

15 Do you have a specific one or two, or I don't
16 know what the right number is that are critical, that we
17 really ought to be looking at today versus farther into
18 the future?

19 MR. DUVAL: You know, I really think it
20 revolves around the economics. I really think that if
21 you want something, let's figure out how it gets paid
22 for.

23 Because, you know, I was on the vehicle side
24 before I went to EPRI and, of course, they force-fed me
25 the utility side of it, in many cases against my will.

1 But the point is that the technology, a lot of
2 the vehicle technology guys are really focused on the
3 vehicle and they're not really -- you know, they don't
4 have a guy full time trying to understand how the
5 different ancillary service markets work, how they're
6 evolving over time.

7 A lot of the time when you talk to these folks
8 and say, by the way, you realize that many of these
9 markets are declining in revenue year over year and they
10 go, really?

11 Because they're getting -- obviously, they're
12 getting more efficient and understand what their
13 competition is.

14 I mean every time I see, you know, from the
15 utility or the ISO perspective we see this flexibility.
16 Oh, you can turn vehicles on and off. You can turn
17 hydrogen production on and off. You can do power to
18 gas, all these things. They're all competitors for the
19 same -- they're all competitors for the same revenues.

20 And I don't think that's something that really
21 is fully understood by all the players and I think that
22 to manage their risk and understand where they can go
23 to.

24 You know, folks like Richard. Richard has an
25 existing business and he can look at these things as a

1 potential add-on or a nice-to-have.

2 But there are folks that for them this might be
3 a much more critical part of what they do and I think
4 they need help understand that.

5 And if it means the program stuff that comes
6 into existence to take advantage of that, then those
7 programs have to be made clear.

8 COMMISSIONER SCOTT: Thank you for that
9 informative presentation.

10 MR. DUVAL: Thank you.

11 MR. MC KINNEY: Great, I'd like to introduce our
12 next speaker, Mr. Richard Lowenthal.

13 So, I mentioned we had a nice array of CEOs and
14 CTOs. Richard is both. He founded ChargePoint in 2007
15 and is now their Chief Technology Officer.

16 He's got previous executive level experience
17 with Cisco, Straticom, Star Den, and Convergent
18 Technologies, and he's also been a Mayor of Cupertino.
19 And is another Engineering Degree from Berkeley.

20 So, Richard, I know you've got a big slide deck.
21 I'd like to offer you a couple more minutes.

22 MR. LOWENTHAL: I'll move fast.

23 MR. MC KINNEY: But, yeah, if you can move --

24 MR. LOWENTHAL: I'll move very fast. But you
25 have paper copies, so if questions come up I'll address

1 them there if I go too fast.

2 So, first of all, I was allowed to give a minute
3 about the company. We're doing very well. You know,
4 we're extremely pleased with the progress of our
5 business.

6 We have 65,000 drivers in our network, now, 16
7 and a half thousand stations. We're shipping about 25
8 stations every day, so quite pleased.

9 In our market, which is the shared charging
10 market, that's a combination of public, workplace,
11 multi-family housing we have about 75 percent market
12 share. So, things are going very well and our growth is
13 good.

14 I want to talk just a minute about what we are.
15 So, we don't view ourselves as a charging station
16 company but, rather, as a charging services company.
17 And these are the services that we offer.

18 For us, charging stations is sort of a sideline.
19 And just I'll talk about one of these services and why
20 it matters to the Commission and that's the ability to
21 get real-time status.

22 So, when I arrived here today I found out,
23 unfortunately, that the two garages right near here all
24 ten EV charging stations were all busy, and I found out
25 from my app., which is good because if you go in the one

1 across the street they charge you \$1.50 even if you
2 don't park.

3 And the closest one available was down the
4 street at 300 Capitol Mall, so that's where I parked.

5 But having the ability, for instance, to find
6 out where an available station is increases the density
7 of use that is the utilization of the equipment because
8 otherwise I didn't even know there was one over at
9 Capitol Mall.

10 So, these kinds of features are quite important.
11 Of course, the billing feature is important, too. And
12 the billing feature is becoming more important. Not as
13 a revenue generator, but as a utilization generator.
14 People are putting very low prices, 25 cents an hour, in
15 order to get more cars per day. If you do that, you get
16 three cars per day on an EVSE, as opposed to one.

17 So, we're seeing the use of these advanced
18 features to be quite important for our market.

19 And consequently, in our market the network
20 charger is becoming the dominant way to deliver charging
21 services.

22 And for instance in the recent PON there were
23 several features that depended on the network charger,
24 as opposed to the stand-alone non-network charger. So,
25 that market is growing quickly.

1 I'm not going to go through these. There are
2 lots of monetary reasons involving synergy with
3 businesses of why they deploy charging stations.

4 Ninety-five percent of our business is paid for
5 by the private sector, not by subsidy. So, we got some
6 help in the early days from subsidy, not much anymore.
7 But because of the reasons on this slide, people buy
8 their own infrastructure.

9 The marking is growing very quickly, the EV
10 market I'm talking about which is, of course, a driver
11 for our business. It's more than doubled this year.
12 We're very pleased with that. It tripled the year
13 before.

14 We're extremely pleased in our target for our
15 plans for growth because the EV market is growing so
16 quickly.

17 The acceleration of it, if you compare it to the
18 first three years of, basically, the previous market is
19 about 4X. So, the EV market is catching up very
20 quickly, the plug-in hybrid and BEV hybrid is catching
21 up very quickly to the hybrid world because it's growing
22 at a much faster rate in its first three years than the
23 plug-in hybrids did.

24 And that applies here. We expect to see
25 California get to two percent cars by 2020, of new sale

1 cars.

2 And that's going to grow into the future
3 nationwide.

4 So, you know, we're plotting out the growth.
5 We're very happy with, at this point, kind of the
6 predictability growth of the EV market. Now, attach
7 rate is an important thing for us. So, what we define
8 attach rate as is the ratio of public charging stations
9 to vehicles, so that runs our business.

10 And, you know, we have goals that are in the 24
11 percent rate. Where we are at today is about eight
12 percent. So, for every 12 cars that goes out we sell
13 one station. We would like to see that higher. We
14 think that there are not enough because in concentrated
15 areas drivers are unhappy because they can't find enough
16 charging stations.

17 I tell people the state of the art for EV
18 drivers now is to walk a half a mile for the last leg.
19 So, they had to walk a mile because the half-mile ones
20 are across the street and they're all busy. The one-
21 mile ones are not busy to this location. And that's too
22 much, we think. We think that the driver has to be
23 within a half a mile of their destination when they stop
24 to charge their car during the day.

25 I had to charge my car during the day because I

1 can't get home if I don't do it, so it's busy charging.
2 So, it's quite important. I couldn't use my EV today
3 without finding one. The mile walk was a little longer
4 than expected.

5 We forecast attach rate. We expect it to get to
6 the 17 percent rate at some point, but that's twice as
7 many stations per car as we see today.

8 And the problem is this one, really, this slide
9 11 I think is key, you get concentrated areas. There
10 are some stations that have no utilization at all and
11 then there's areas like around the Energy Commission,
12 where the stations are extremely busy and they're busy
13 every day.

14 And we forecast that for our customers and we
15 tell our customers every month how their stations are
16 doing and you get these hot spots. So, this even within
17 once city you get hot spots and cold spots, but the hot
18 spots are a problem.

19 And what I would suggest is a possible policy
20 idea for the Energy Commission is to fund growth. That
21 is, where there's a demonstrated busy location fund more
22 stations there to avoid the problems of stranded assets
23 or wasted assets that you put out where people don't
24 charge, like at 35 Street.

25 We have a little problem here. This slide 12

1 shows where we could use some help. The vehicle sales
2 are outrunning the charging station sales and so that's
3 going to create increasing problems like I suffered
4 today in Sacramento.

5 So, we need to change this equation in order to
6 not see drivers get frustrated by the inability to
7 charge their vehicles.

8 So, this is just another way to look at it and
9 I'll leave that to you.

10 But, basically, current attach rate is 7-to-1,
11 seven cars. I said eight, but it's actually falling,
12 and that's too high.

13 Now, what we see in workplaces -- so, for us, 62
14 percent of our business is workplace. This is a
15 sophisticated workplace shown on this slide.

16 And what we can see is every time they add ports
17 more cars come.

18 So, we track the number of unique drivers that
19 visit our stations and the number of stations, the
20 number of stations in each parking lot to see how
21 utilization tracks.

22 In this workplace what you see is that no matter
23 how many stations and cars they have, they have 20 uses
24 per port, per month, meaning every workday one car.

25 We are driving that to three. Three cars can

1 charge on one station per day. And we'll talk about why
2 that's true in a minute, why we're doing that.

3 There are some places that are worse, so the
4 left chart here is the San Francisco Airport. The green
5 line is how many unique drivers we see at those
6 stations, a lot. And now, at the San Francisco Airport,
7 for instance, you have to use one of the Smart Phone
8 apps in order to find an available station because your
9 favorite terminal or the one near your airline is
10 frequently busy, now.

11 So, all of these we're getting a little bit
12 behind.

13 We've estimated how much money it would cost.
14 It's about a billion dollars needed in order to get to
15 the 2025 -- or the 2020 goals that the Governor has.

16 Most of that will come from the private sector.
17 As I said, 95 percent of our business is private sector
18 at this point. But a billion dollars needs to be found
19 to get to the 2020 number of charging stations needed to
20 support the rapid growth of EVs in California.

21 I wanted to mention a little bit about DC
22 chargers. We don't manufacture a DC charger but we put
23 them on our network. They are very popular for us.
24 They are moneymakers in terms of cash flow.

25 The only issue ever being the demand charges.

1 We are shipping one a day, now.

2 I would recommend a thought that there's a
3 proposal in Hawaii, don't know if it's passed yet, or
4 not, but it will, which is that the demand chargers for
5 DC charging are waived if demand response is implemental
6 on the station.

7 Without that, especially in the early adoption
8 phase, you can't get cash flow to work on a DC charger
9 with demand charges. So, it either has to be subsidized
10 in the early days or some program like this.

11 I'll go quickly through a couple of these. The
12 biggest problem we have is that the landlord and the
13 driver are not the same person and have different
14 motivations.

15 So, it's hard to sell into apartments, hard to
16 sell into condominiums, hard to sell in business parks
17 where the business owner doesn't own the lot.

18 And so, we are looking for solutions for that.
19 It's a severe problem.

20 Installations are expensive. Our answer to that
21 is a technology answer. So, we're moving from one car
22 per circuit per day which what you get, for instance,
23 with level one, to an average now of three cars per
24 circuit per day.

25 Because all the money -- last year when I was

1 here a station and the installation had the same price
2 and now stations are significantly cheaper than the
3 installation. So, we're moving technology to see that
4 we get three cars per day per circuit in order to
5 amortize the high cost of installation. And we're doing
6 that primarily with technology.

7 I don't have time to go through the rest of
8 these. I would say probably another important one is
9 the option of Handbook 130. That's the Departments of
10 Weights and Measures standards for what the public --
11 regulation on behalf of the public for charging at
12 public stations. That is setting prices, providing
13 receipts, all of those kinds of things like you get at a
14 gas station.

15 So, the last slide I'll talk about, the
16 Department -- we could use help on this HB 130. In
17 California, that means we need the Department of Food
18 and Agriculture to adopt it so that there's a standard
19 for public charging, so that the consumer gets what they
20 expect.

21 We need to go to a policy, like we have for
22 condominiums now, which is where if a business or an
23 apartment owner will pay for their EVSE, the property
24 owner has to allow it. And that may require legislation
25 to get that done, just as it required legislation to get

1 it done for condominium owners.

2 We know what the right number is. You want one
3 port for two EVs if you want to keep people very happy.
4 We are far from that.

5 We still have a fair amount of chicken and egg
6 problem where people don't expect the cars to come.

7 So, you'll hear in an apartment building, we
8 never see any cars so we're not putting in an
9 infrastructure. And of course, obviously, the tenant
10 will not buy a car if they can't plug it in.

11 So, we still have that problem and probably will
12 have to force our way through that. Funding could help
13 a lot there because the obstacle is largely that the
14 apartment building doesn't want to part with their
15 money.

16 But even then, even if the tenant is willing to
17 pay today, they can't.

18 And then there's a particular thing which I
19 think that the Commission should consider to fund, which
20 is the panel upgrade for apartment buildings and
21 condominiums because we can get the tenant to pay for
22 the same -- the equivalent price that they would pay if
23 they owned their own home, but we can't get them to pay
24 the \$30,000 that it takes to get a condominium or an
25 apartment building ready to install EVSE.

1 So, there's a common area piece that has to be
2 done and nobody wants to pay that \$30,000.

3 So, we could use a grant program, I think, to
4 just address the panel readiness of condominiums and
5 apartment buildings. It's a severe problem. They will
6 not do it.

7 And, you know, 41 percent of Californians live
8 in apartments or condominiums and they have no access to
9 the EV market because of this issue. So, if you can
10 help there, it would be great.

11 And finally, I think we could use more leverage
12 funding. So, we can now bring bank financing into all
13 of our projects, so to the extent that the State
14 requires higher and higher match, we would encourage
15 that and that is stretch your money.

16 Because if you allow the banks to pay part of
17 the bills, we can get that financing. I have a \$100
18 million line of credit just for us that we can apply to
19 that, to matching grants that you might provide.

20 Thank you very much.

21 COMMISSIONER SCOTT: Thank you. So, I had a
22 couple of questions as we went along and I'll try to ask
23 them quickly.

24 So, you mentioned back on slide 9 that for every
25 12 cars we have one station and that you'd like to see

1 that radio go down. And then you mentioned twice as
2 many stations per car. So, are you thinking we have to
3 get to a 6-to-1 ratio?

4 MR. LOWENTHAL: So, what people -- what drivers
5 are happy with is 2-to-1, but that's not feasible.

6 So, our long range view, I have it here, is to
7 get to 17 percent as opposed to the current number,
8 which is somewhere about seven percent.

9 COMMISSIONER SCOTT: I see, okay.

10 MR. LOWENTHAL: That is for seven -- there will
11 be a public charging station or a shared charging
12 station for multiply the numbers of cars times .17.

13 COMMISSIONER SCOTT: Okay and then on slide 11
14 you mentioned that -- you showed the stations where
15 we've got lots of utilization versus the stations where
16 we don't have as much utilization. And I was
17 thinking -- and recommended that maybe the Energy
18 Commission could fund growth in the areas that are known
19 to be busy.

20 And I thought about this and it's -- this is
21 very data-intensive. So, is this the kind of data that
22 ChargePoint provides to the Energy Commission? I was
23 just trying to think where does the Commission get that
24 kind of data to then know where some of the busier
25 places are that we might look at funding.

1 MR. LOWENTHAL: That's very good. So, there
2 isn't a mechanism now. We are just concluding a
3 contract right now with UC Davis, so we will have a
4 channel to get that out to the public.

5 COMMISSIONER SCOTT: Okay, great. And then I
6 also thought about how we balance that with the map that
7 Mark showed in terms of we've got a concentration in a
8 lot of the busy cities, and then how do you broaden that
9 network right out across the whole State?

10 MR. LOWENTHAL: So, Commissioner Scott, let me
11 just say that your policies tied to funding make a big
12 difference.

13 COMMISSIONER SCOTT: Uh-huh.

14 MR. LOWENTHAL: So, for instance in the recent
15 PONs that were just announced there was a policy
16 requiring open network connections between EVSE and the
17 operating network, which caused us to have to develop
18 some products, which was good for the industry.

19 So, you could also, for instance, tag this to
20 say there has to be a demonstrated case of high
21 utilization.

22 COMMISSIONER SCOTT: Uh-hum.

23 MR. LOWENTHAL: That is you could condition any
24 funding that goes out based on us demonstrating the fact
25 that it is a busy location.

1 COMMISSIONER SCOTT: Got it, got it.

2 And then one last one, I was just thinking in
3 terms of the technology and how it may change over the
4 next ten years or farther. And you mentioned, so we
5 first started where you just had one car per circuit,
6 and now we're to a place where we get three cars per
7 circuit.

8 MR. LOWENTHAL: Right.

9 COMMISSIONER SCOTT: Do you see a future where
10 we can do more cars per circuit?

11 MR. LOWENTHAL: Yes, so there's -- definitely
12 that's true. And even more so it's now shifting to a
13 panel allocation issue. So, there's technology
14 solutions now for that where the panel is used in the
15 most efficient way to charge cars.

16 So the cars, for instance, that are on a circuit
17 but not charging don't use any panel capacity. So,
18 traditionally, that's been a static calculation, but a
19 huge cost driver, as I said, \$30,000 in a typical
20 condominium.

21 So, the next technology will be such that we use
22 the energy allocation in a panel more wisely and fully
23 occupy that. And those kind of technologies are
24 underway at our company and others.

25 COMMISSIONER SCOTT: Great.

1 MR. MC KINNEY: Commissioner, can I add
2 something really quick?

3 COMMISSIONER SCOTT: Yes.

4 MR. DUVAL: So, one of the things as the -- so,
5 this is really good at understanding where you have
6 infrastructure that's over-used, over-subscribed and you
7 need more.

8 But also you'll have to identify under-served
9 areas. And the two biggest examples -- the two best
10 examples of under-served areas now are areas outside the
11 four major metropolitan areas, and then also -- so, I
12 don't want to call them rural, because they're not
13 really rural, where there is adoption and you can plot
14 traffic patterns that would lead to the need for EV
15 charging.

16 And then, of course, multi-unit dwellings, I
17 don't think there's any disagreement there that those
18 are also under-served.

19 COMMISSIONER SCOTT: Thank you.

20 MR. MC KINNEY: Great, I'd like to turn to our
21 next speaker. Thank you very much, Richard.

22 MR. LOWENTHAL: You're welcome.

23 MR. MC KINNEY: Our next panelist is Edward
24 Kjaer, who is Director of Transportation Electrification
25 at Southern California Edison.

1 And in our efforts to kind of catch back up with
2 our schedule today he's got a beautiful biography, and
3 we're going to post that and just get to your remarks,
4 so Edward.

5 MR. KJAER: Well, that's the first introduction,
6 "a beautiful biography".

7 (Laughter)

8 MR. KJAER: Thank you very much, Commissioner
9 Scott, for hosting this event.

10 I think, you know, what's kind of encouraging I
11 think about today is many of us in the room have been
12 doing this for a long time and in many times in the past
13 it was about what we think the future will look like.

14 And I think in this particular space, in plug-in
15 electric vehicles, clearly the market is real. What
16 you're seeing today is the sharing or real data.

17 And I think, you know, more and more every day
18 we're getting better at truly understanding what is
19 actually going on in the marketplace.

20 So, from my perspective what I wanted to -- I
21 only have a couple of slides. And so, because I was
22 hoping we would get into some dialogue and the two
23 previous speakers had lots of slides.

24 So, I think overall my comments are really
25 couched in we need to really work to perhaps have a

1 better balance at kind of near-term versus long-term.

2 We tend to, I think, gravitate towards high
3 technology, complex business models and solutions,
4 sometimes solutions that are kind of looking for
5 problems to solve.

6 And Anthony Eggert, I think, set the tone very
7 well at the very beginning of this workshop when he
8 basically said that there is a heck of a task in front
9 of us to get to 2050.

10 And, you know, I would suggest that we'll never
11 get to 2050 if we don't start focusing on the here and
12 the now at accelerating the market.

13 I think that Richard is right we're off to a
14 good start, a really good start when you compare it to
15 the hybrid market from a decade ago.

16 But I don't think that it's a done deal. I
17 don't think we're over the valley, the so-called valley
18 of death by any stretch of the imagination.

19 So, what I'm advocating for is a balance of that
20 long-term push towards technology solutions, balance
21 that with near-term, low-cost simple solutions that
22 reduce barriers and just fundamentally get more cars on
23 the road, driving home and simply plugging into the
24 system.

25 So, having said that as kind of the opening,

1 what I want to do is just set the table a little bit, if
2 I can have the first slide, please. Apparently I can't
3 click it. There we go.

4 So, this kind of helps to just put in context
5 kind of where we are today with the market for plug-in
6 electric vehicles. As I said, it's off to a good start,
7 but it's also really, really small.

8 1.5 million cars got sold in California last
9 year, 117,000 were hybrid. So, 1.5 million was
10 conventional ICAs, 117,000 HEVs. And then you can see
11 between BEVs and the plug-in hybrids 43,000 units, so
12 two and a half percent. So, it's a very, very nascent
13 market today.

14 And again, the focus should be on that --
15 finding that balance, that sweet spot between the
16 longer-term strategies that are technology, and laden
17 and complex, and nearer-term how do you accelerate the
18 market.

19 Because if we don't accelerate the market, we're
20 never going to be able to, you know, stabilize those
21 longer-term business models that need volume, need
22 through put.

23 The next slide, let's go to -- we'll skip this
24 one and we'll go to the next one in the interest of
25 time.

1 Okay, so what's kind of interesting about this
2 is just kind of helps to put in perspective, I think,
3 the charging event that we're talking about.

4 So, roughly speaking, you know, 70, 80 percent
5 of the market is -- has daily trips of less than 20
6 miles. And if you take a look at all the miles traveled
7 both for commuting and shopping, you know, basically the
8 average is less than 30 miles.

9 And so if everyone fuels up at home, and that's
10 certainly the kind of behavior that we want to encourage
11 because that's when the energy costs are the lowest, and
12 that's when the load is the most valuable to the system
13 because that's when we have a lot of excess capacity,
14 and then drives to their location.

15 You can see that for a car like the Toyota Prius
16 to have location charging, like workplace charging, you
17 can literally double the electric vehicle miles traveled
18 for that car.

19 You are doubling the Fords, which have about 20
20 miles of all-electric range.

21 And, you know, the Volt, you're not doing too
22 much on the Volt because it's already able to deliver 35
23 to 40 miles of all-electric range.

24 And you're not doing maybe so much for the pure
25 battery electric car because they have about 80 miles of

1 all-electric range capability, and yet they're only
2 using about 30, 35 miles of that battery every day.

3 So, regardless of the battery size, you know,
4 you don't necessarily drive any differently. About 80
5 percent of the market is commuting less than 20 miles a
6 day.

7 So, when you look at the amount, the time that
8 it takes to fuel these vehicles at level one, even at
9 level one you can see that in an eight-hour day you're
10 only using up to about five hours. It's more like,
11 probably, four hours.

12 So, we have plenty of time to fuel cars, even at
13 level one, in nonresidential situations.

14 And you can see that it's about -- these are i-
15 Tunes transactions. You know, we tend to get very
16 excited about the ability to move energy backwards and
17 forwards, to do energy arbitrage. We're dealing with i-
18 Tunes transactions.

19 We're dealing with a bunch of hairdryers running
20 at level one. And so, I think we've just got to kind of
21 put that into perspective as we think about, you know,
22 how we design the system.

23 And again, I think we need that balance between,
24 you know, faster charging and low, slow, simple, low-
25 cost charging. Again, a balance, it's not all one or

1 the other, but a balance.

2 The next slide. So, this really speaks very
3 much to that point. So, in the case of Southern
4 California Edison's area, we -- and this is interesting
5 because the market is not defined -- we tend to define
6 the market in one way, I think, in the State, and that's
7 dangerous because I think Northern California and
8 Southern California are different. And I think the
9 kinds of vehicles that are being purchased are
10 different. And the charging, the propensity of level
11 two charging versus level one charging is different.

12 So by that what I mean is that in our area we
13 have about, now, about 22,000 plug-in vehicle customers
14 and the majority of our customers, we skew towards plug-
15 in hybrids, rather than battery electrics whereas, up in
16 the Bay Area it's more battery electrics over plug-in
17 hybrids.

18 And we skew towards a lot more level one
19 charging than we ever thought.

20 So, I think what's happening is that customers
21 are simply buying the cars, driving them home and
22 plugging them in. And you know what, the grid can
23 handle it. In fact, the grid really likes this level
24 one.

25 And as we think about, you know, focusing on

1 that kind of near-term, more balanced approach then we
2 think -- I think we need to be thinking about policies.
3 For example, there are policies today that are sort of
4 saying, well, faster charging is better. Well, why is
5 that? Why do we think that?

6 That's an old paradigm, you know, called the gas
7 station model.

8 So, I think we need to really be thinking about
9 a balanced approach, this near-term versus long-term.

10 And from an R&D perspective, in terms of the
11 Energy Commission, I think there's an opportunity, and I
12 think this speaks very much to a point Richard was
13 making.

14 It is that we can get more cars on a circuit.
15 In fact, I was at UCLA a couple of days ago and the
16 engineering school there has been working for a couple
17 of years on an algorithm-based product. And they showed
18 me level one, a level one charge box with four ports,
19 and octopus. And they can literally sequence four cars
20 off a circuit at level one.

21 And if only a couple of cars are charging on
22 that circuit, then they can up the speed at the rate of
23 the charging.

24 And then they have level two capability as well,
25 again, a box with four -- the capability to charge four

1 cars.

2 So the costs are -- you know, it's about
3 reducing the cost and that's very much, I think, the
4 point that Richard was making, as well as Mark, is that
5 we've got to lower the costs. We've got to make it
6 simpler to connect to the system.

7 And I think we also need to really work on
8 building out low cost, simple workplace charging that is
9 highly visible. Again, finding that balance, not just
10 the low cost, but finding that balance.

11 But workplace is where these cars are parked for
12 eight hours a day.

13 And so, this chart really is basically saying,
14 you know, 75 percent or so of the fueling is done at
15 home and then 15 or 20 percent is the workplace. And
16 then the last piece of this is this public or
17 opportunistic charging.

18 But workplace charging is really going to help
19 increase electric vehicle miles traveled, particularly
20 for plug-in hybrid vehicles because you're going to
21 effectively double the range of Priuses and double the
22 range of Fords, and put a little bit extra range on for
23 the Volts.

24 And then I think this kind of judicious amount
25 of fast charging for the battery electric cars is the

1 way to go for that part of the market.

2 So, I think, you know, bottom line balancing the
3 near-term versus the long-term.

4 The other piece that we critically need, I
5 think, in the State to help accelerate the market is we
6 need fundamental education. We need market education.

7 We have extremely low awareness. And so, there
8 are organizations that are trying to stand up effective
9 and sustained education programs, organizations like the
10 Electric Drive Transportation Association in Washington.

11 I really encourage the State to explore
12 opportunities to develop and execute, and sustain broad
13 education programs to just increase fundamental
14 awareness. Awareness about why electric vehicles, plug-
15 in electric vehicles make sense and why connecting to
16 the grid here in California makes a lot of sense.

17 Electricity is fundamentally a dollar a gallon
18 equivalent. We need to get that message out into the
19 marketplace. Thank you.

20 COMMISSIONER SCOTT: Thanks, that was great. I
21 will only ask one quick question, recognizing that we
22 have a couple more speakers.

23 I was just looking, so at this pyramid chart
24 here, do you think if we can sort of crack the multi-
25 family dwelling, and then also increase the workplace

1 charging, I mean do you see in the future maybe there's
2 additional yellow in the workplace part of this chart,
3 or how do you see this kind of overall picture changing?

4 MR. KJAER: I think workplace charging will
5 increase the electric vehicle miles traveled.

6 Now, workplace might become even more critical
7 in the future, 15, 20 years out, potentially, if we get
8 into this duck trap situation, right, where -- so, where
9 we may just simply say we'll take all the load you can
10 give us.

11 But I think that also speaks to the question
12 that you raised about vehicle to grid is that -- and the
13 way Mark answered it, I would only add an extra point
14 and that is that the grid is constantly changing. The
15 grid is constantly adapting.

16 So, it's really difficult to build a business
17 model today around vehicle to grid when at scale we may
18 have a whole different set of challenges. For instance,
19 over-capacity during the day, by which case we won't
20 want vehicle to grid, we'll want load.

21 And so, the whole definition of on-peak and off-
22 peak may be changing in the future, as well.

23 So, I just think it's -- we need to be careful
24 not to, you know, over commit today, and not to -- you
25 know, again, it comes back to that balance. Don't spend

1 so much time trying to pull things out of the lab and
2 stand them up in the marketplace before the market is
3 really ready.

4 You know, again, more of a balanced focus on
5 just how do we get more cars on the road, how do we get
6 more cars connecting to the system, and doing it in as
7 cost-effective, non-complicated way as we can.

8 MR. MC KINNEY: Great, thank you, Edward.

9 Our next speaker is our remote presenter,
10 Professor DeShazo, from the UCLA Luskin Institute.

11 And, Lynette, are we good to go there?

12 So, Professor DeShazo is the Director of the
13 Luskin Institute for Innovation at UCLA and a Professor
14 and Vice-Chair of the Department of Public Policy, also
15 with the Luskin School at UCLA.

16 So, do we have you, Professor DeShazo?

17 Shall we go to Dan Davids and go back to J.R.?

18 MS. RAITT: J.R., go ahead.

19 MR. MC KINNEY: So, it's not a connection issue,
20 he's just not there.

21 Okay, why don't we turn to Dan Davis and then,
22 hopefully, Professor DeShazo can join us right before
23 the lunch break.

24 Dan Davids is the Chair of Plug In America. And
25 Dan -- well, I'm just going to have to suspend the bios

1 here so we can kind of get back on schedule.

2 But Plug In America is really the leading kind
3 of consumer voice in the adoption of plug-in vehicles,
4 so Mr. Davids.

5 MR. DAVIDS: Great, thanks. Well, if I have to
6 say, hats off to you, Jim, for creating the order in
7 which we spoke because I think the three previous
8 speakers have -- there really isn't anything that I
9 heard that I think I disagree with. I think they've
10 really presented the state of things and made cogent
11 remarks and good recommendations.

12 And also, they showed up, Mark and Richard, with
13 more detailed slides, and we were more in the camp of --
14 and simply not having the time to put together a lot of
15 detailed slides, so that's good, so there isn't
16 duplication of effort.

17 We did, however, spend quite a bit of time
18 looking at your questions at Plug In America, and
19 actually now, I think it's very clear based on the fact
20 that we've had such good presentations before me that my
21 approach, what I'm trying to do, which is at a bit of a
22 higher level to help the board in its planning and
23 decision making going forward, was the right way to go.

24 So, I'll just say on the opening slide here, by
25 the way, the two signs, keep those in mind and we'll

1 talk about those in a little bit.

2 So, the next slide, yeah, you can go ahead and
3 display all of them on here. Oh, wait, this is the old
4 version. Oh, goodness gracious.

5 All right, can we go ahead? Okay, stop on that
6 one for a second. So the wonders of software PowerPoint
7 seems to not want to put my slides in the order that I
8 told it to.

9 Plug In America, just briefly, over 30,000
10 supporters. We were heavily involved in raising the
11 amount of funding years ago, basically, the \$7,500 tax
12 credit that we're all enjoying in purchasing these cars
13 now.

14 We do an awful lot of work, both with consumers
15 and at the policy level and, increasingly, you know,
16 consulting work with municipalities and even,
17 occasionally, automakers and utilities.

18 Our sort of largest claim to fame is National
19 Plug-In Day, which if you'll see from this slide there
20 it's now been renamed National Drive Electric Week.
21 This will be our fourth year with that.

22 We went from 25 cities the first year to 50 the
23 second year, 100 last year. Our goal this year is 200
24 cities and actually, probably, a half-dozen to maybe a
25 dozen of those in Europe.

1 So, that has turned out to be an extremely
2 effective way -- you talk about bang for the buck and
3 how to spend your money, because CCSE, which tracks the,
4 you know, rebate applications has documented a spike in
5 sales in the week immediately after when we hold these
6 National Plug-In Day events.

7 And the key there, of course, is getting people
8 in the cars, in a neutral environment. Most of the cars
9 are supplied by EV owners, plug-in owners. A
10 nonthreatening environment to ask questions and kind of
11 just get your good experience with the cars, so that has
12 really worked well.

13 And also, our Plug In At Work effort is just
14 massively expanding this year, where we go to workplaces
15 and hold -- actually, they turn out to be pretty
16 boutique events. Each workplace is quite different, has
17 different requirements, both in terms of their internal
18 policies and how they want things handled. And so,
19 we're able to respond and we've gotten across-the-board,
20 you know, a very positive response from that.

21 And again, it generates car sales. It gets
22 vehicles on the road.

23 And then kind of lastly, I mentioned that we've
24 been involved for a number of years in actually creating
25 the community readiness, if you will, guidelines.

1 California actually was a little behind some of
2 the other states, like Washington and Hawaii, but now
3 has come up to at least parity, I think, in that regard.
4 And those signs, as a matter of fact, were developed
5 elsewhere but now are pretty much going -- been adopted
6 in California and are going nationwide. That's just one
7 example of that.

8 So, we go back, you know, to the ZEV mandate,
9 you know, the original one, we've kind of been there,
10 done that. We've walked that mile in Richard's shoes to
11 public charging stations. A few that existed back in
12 the day.

13 And with that we'll move to the next slide.
14 Great, oh, just I'm not going to go through all these
15 but last year we happened to, you know, support six
16 different pieces of legislation which were ready to be
17 signed by the Governor, and we worked with the
18 Governor's Office to get him to do all those on one day,
19 at the same time, on National Plug-In Day.

20 So, that's the kind of thing Plug In America,
21 you know, does is to try and look for opportunities like
22 that to raise the awareness in the marketplace, as Ed so
23 clearly points out is a key component of things.

24 We also were kind of the first to again apply
25 when we got to 100,000 electric vehicles, which is just

1 about exactly a year ago, now, nationwide, and shown a
2 light on that.

3 Right now, matter of fact, we're about a week,
4 maybe ten days away, from looking at our numbers,
5 200,000.

6 We think we're probably going to keep our powder
7 dry and more celebrate when we get to 250,000, which we
8 think might actually be at this year's National Drive
9 Electric Week.

10 Next. Okay, so these are -- I saw that we
11 ordered the strategic goals because when I saw the
12 questions and looked at these goals, the immediate thing
13 that popped into my mind was prioritization. You know,
14 where's the best place to spend money to get the most
15 vehicles on the road the soonest?

16 So, I'm really pleased to hear, you know, my
17 colleagues point out, repeatedly, the need for
18 accelerating the pace of getting these cars on the road.

19 That certainly is not just a good thing for
20 building any market, but it's also essentially needed if
21 we're going to be able to meet the climate goals.

22 I mean, if it takes a great deal of effort to
23 get a sale and get a car on the road five years from
24 now, that's not going to make anywhere near as much
25 effort as if you get that car on the road now. That's

1 just the way the chemistry and physics of the
2 atmosphere, you know, works.

3 So, keeping the climate sort of model in mind,
4 we certainly want to bring -- and so that's one of my
5 key messages is a real sense of urgency around thinking
6 about everything that you do, everything that the
7 Commission does is it consistent with getting more cars
8 on the road sooner.

9 And so, that's kind of how I -- this isn't a
10 strict prioritization, but that's kind of the way we
11 looked at it.

12 So, the -- yeah, okay, so that's how that's
13 reordered. And I'm going to definitely to down there
14 sort of at the bottom, things like storage on DC fast
15 networks. I think Ed is completely dead on.

16 What's going on, on the networks now is changing
17 day by day. I mean, when we started all of this, you
18 know, five, ten years ago there was this big assumption,
19 oh, we want to charge off peak, right? Well, now we've
20 got all these renewables coming on the grid and we've
21 got duct charts and, you know, excess green capacity
22 during the day. And so, that wasn't foreseen.

23 So, what's going to be the role of storage and
24 DC fast-charging networks or, you know, V2G?

25 Our view would be to not put, you know, too much

1 effort and money towards those right now because they're
2 still in flux. There's a lot of technology still to
3 develop there and they're not really, certainly, going
4 to answer my overall or arching concern which is to get
5 more vehicles on the road sooner.

6 And on the commercial truck fleets, it's a part
7 of it that we don't really focus on that at Plug In
8 America. And everything, everything with a plug, but
9 I'll defer to my colleagues for that one.

10 So, next, okay, let's stop on that one. This
11 one is just -- you know, I wanted to bring a little bit
12 of humor into the day's proceeding. That certainly is
13 not a real Prius. Someone was quite creative with
14 Photoshop.

15 But I'm trying to make the point, my next point
16 which is it's pretty easy to get down in the weeds and
17 start talking about V2G and, you know, battery capacity,
18 and battery chemistries, and storage on the network, and
19 all these different things and here's sort of a -- you
20 know, this is probably not out of the realm of
21 possibilities. Someone could say, hey, well, this is
22 the way we ought to go. We ought to tap into the
23 catenary systems of the nation's trolley bus lines and
24 power our vehicles.

25 And so, what I want -- my sort of message here

1 is just kind of remove the complexity of things when we
2 go outside this room and we talk to the public. Because
3 the point that has been made is the vast majority of the
4 people outside this room are still very unaware of
5 electric vehicles, and their advantages, and what they
6 do for the climate, and for their pocketbook.

7 So, if we can remove that complexity and make
8 it, you know, not look like there are all these
9 incredible technical barriers that have to be overcome
10 before the vehicles are ready.

11 Part of the reason Plug In America exists is
12 these cars were put in our hands with no public charging
13 infrastructure out there whatsoever and we've discovered
14 what a better lifestyle it was, how much more pleasant
15 they were to drive, how much money they saved us, how
16 good they worked for the environment, how we had the
17 infrastructure at home with 124 volts. And geez,
18 everybody should do this.

19 So, we didn't see technical barriers out there
20 as the big thing at all. The biggest thing was nobody
21 was making the cars. So, that's why our focus is
22 always, you know, getting cars on the road.

23 So, next, if we can go back to the one that --
24 that one, there we go.

25 Okay, so, yeah, my first point, try and remove

1 the impression of EV complexity.

2 If I could wave a magic wand, everything we
3 could do to make permitting for putting in charging, be
4 it at home, or workplaces, or MUDs, to make that cheaper
5 and simpler, that's something we really think is key.

6 It's disheartening to find that the actual
7 installation costs are kind of rising at the time when
8 equipment costs are going down.

9 I don't think we really saw that with solar but,
10 yeah, we need to fix that.

11 As far as charging stations in MUDs, again, our
12 point of view is supported by the pyramid. We would
13 prioritize spending money on workplace over MUDs. Not
14 to say that the MUD problem isn't worth solving, it
15 absolutely is. People who are garage challenged and
16 want to drive these vehicles ought to be able to, you
17 know, do that.

18 But, certainly, you know, a \$30,000 barrier just
19 to get the panel upgraded so that the first owner in an
20 MUD can get a car, and you start thinking about, well,
21 if we spent \$30,000 in incentives or other sorts of ways
22 to sell cars, we could probably put five or ten vehicles
23 on the road for the same amount of money and that's
24 better.

25 And I'm not -- you know, I can only feel for the

1 folks in the MUDs.

2 And so the next one would be signage and I think
3 this one was kind of missed, I think, in the big ERA
4 grants. And if we had been consulted in -- we didn't
5 know those grants were under development, backed by DOE,
6 in the D.C., but we certainly would have had them
7 include a component for signage and to make it easier
8 for Richard and the other companies that installed
9 stations out there.

10 I want to give a big, you know, shout out to
11 SMUD here, locally. I just was, two weeks ago, at their
12 opening of a DC fast charger at their campus, and their
13 former -- at the former -- under the solar array of a
14 former hydrogen fueling station. It's got both CHATMO
15 (phonetic) and SAE.

16 And one of the great things about it is they
17 used exactly the latest and greatest of Caltrans
18 approved, those signs that you saw in my opening slide
19 there, from the street, through the parking lot, and at
20 the station. And that's exactly the way it should be
21 done.

22 And they also even have another sign which
23 clearly lists how much they charge per kilowatt.
24 They're doing it on a kilowatt hour basis, by the way,
25 which is 22 cents a kilowatt hour.

1 And so, we really think that that's something
2 that should be emphasized and would help people get to
3 the stations and increase the utilization that Richard
4 talked about.

5 Credit cards we think give us a lot of
6 interoperability. We don't think the government should
7 be getting overly involved in trying to tell the
8 industry how to make their billing systems
9 interoperable. There's already an industry trade group
10 Richard's involved in that's making that all happen. I
11 think that's going to sort itself out.

12 DC fast charging, we think so as well. There's
13 a lot of innovation happening there. The cost of the
14 equipment, you know, is plummeting.

15 I would put efforts on removing the barriers to
16 get the trenching and the installation costs happening.

17 So, with that I think I'll wrap that up.

18 Oh, by the way, I looked up 70 megapascals
19 because, again, from the consumer -- I mean I'm a
20 physicist, but from the consumer's point of view I have
21 to admit, I don't have a feel for a megapascal. But I
22 looked up the conversion and 70 megapascals is 10,000
23 PSI.

24 So, I'm hoping by the time the hydrogen stations
25 open that it will say 10,000 PSI because I think that

1 means something to people and 70 megapascals, you know,
2 doesn't. But anyway, right.

3 MR. MC KINNEY: Thank you very much, Dan,
4 appreciate it.

5 COMMISSIONER SCOTT: Yeah, thank you.
6 Recognizing that I and potentially one other speaker
7 stand between everyone and lunch, I won't ask this
8 question for an answer right now, but I will ask it for
9 potentially, if you have answers to it, if you'll be
10 sure to get it to us on the record and submit in the
11 comments so that we have it.

12 And that is, Dan, you mentioned this and someone
13 else did, as well, that the installation costs are
14 rising when the equipment costs are going down, and I
15 just think that would be something useful for us to have
16 more information on.

17 MR. DAVIDS: May be rising.

18 COMMISSIONER SCOTT: May be rising, okay.

19 MR. DAVIDS: I mean everything has to be looked
20 at in context.

21 COMMISSIONER SCOTT: Okay, thank you.

22 Did we get the Professor?

23 MS. RAITT: Go ahead, J.R.

24 MR. DE SHAZO: Hello? Good morning, can you
25 hear me?

1 MR. MC KINNEY: Very well, thank you. Please
2 proceed, Professor DeShazo.

3 MR. DE SHAZO: All right. Commissioner Scott,
4 thank you very much for hosting this workshop. I am
5 going to focus my remarks on the next five to ten years
6 in terms of goals, and keep this very brief and very
7 focused on policy, and essentially try and reflect the
8 reality on the ground tier in Southern California.

9 We've been analyzing the 325 or so stations here
10 in the Southern California Association of Government
11 area.

12 And so, if we could move to the next slide? The
13 first thing I'd like to say is we are still struggling
14 to develop the methods for evaluating how well we are
15 siting stations. And I think this is an area where
16 universities, and nonprofits, and other stakeholders can
17 make an important contribution.

18 I think we should have discussions about how to
19 best develop study methods and evaluate those methods
20 using utilization data.

21 But I'm going to focus at a high level on
22 station siting policies and suggest that the future
23 really is going to involve understanding the needs of
24 building owners and managers, echoing Richard's
25 comments.

1 And then also suggest that the supply of
2 stations should follow the vehicles during the day. I
3 think we -- again, this goes back to the siting
4 question. We all -- all the municipal metropolitan
5 siting organizations have traveled the man models that
6 predict where the PEVs are in the morning and the
7 afternoon. We're not utilizing any of that information
8 very effectively thus far.

9 And then the last policy area revolves around
10 designing more efficient driver access, which will pick
11 upon some of Dan's recent comments.

12 Can we go to the next slide, please? So, I'm
13 going to focus exclusively on MUDs and public access.
14 And I want to suggest that the market has already hit
15 the wall when it comes to MUDs.

16 In urban areas, there's a tremendous latent
17 demand for PEVs by MUD dwellers in urban areas. They
18 represent over 65 percent of all drivers, while the
19 number is 41 for the State.

20 And in the areas where these vehicles are taking
21 off, MUD residents make up the super majority of vehicle
22 owners and currently cannot access this market.

23 So, I think, you know, we may in five to six
24 years have vehicles that have much longer electric
25 ranges, which will help solve some of the workplace

1 charging challenges, but that won't solve the MUD
2 challenge. You know, improving the vehicle isn't going
3 to make it, necessarily, easier to get them into these
4 environments.

5 So, I think for the CEC the MUDs represent,
6 hands down, the biggest barrier to market growth.

7 And then I'd like to make some suggestions about
8 policy innovations that the CEC might consider.

9 We've all talked about the need to have, in both
10 workplaces and for building owners, an opportunity for
11 them to pre-commit to programs and to communicate with
12 their employees and their residents that they are an
13 easy, friendly environment and they will install
14 charging stations when their employees or drivers are
15 ready to purchase the vehicles.

16 So, this would be a program where they announce
17 it without having to spend any money up front, and we
18 then complement that program participation with
19 technical assistance and financial incentives that allow
20 them to make good on that commitment to their employees
21 or their residents.

22 So, a voluntary pre-commitment program I think
23 is very much needed. It will expand awareness of
24 vehicle readiness, which is one of the greatest
25 challenges that we have currently.

1 Second, I think right now I would characterize
2 most of the grant making that goes on as voluntary. But
3 I think that historically we would all recognize that
4 our programs have been very supply driven, where we have
5 contractors who by a certain time have to have a certain
6 number of stations in the ground.

7 And that has led to considerable stranded
8 capital here in Southern California, I believe.

9 If we have voluntary installations where there's
10 a sustained pool of financing or capital such that when
11 site hosts are ready to participate they can do so under
12 terms that sort of meet their local need, then I think
13 we'll move towards a program that grows with the market.

14 Finally, on program design, because of the
15 challenges that MUDs face and certain workplaces, I
16 think we need to think carefully about a graduated
17 mandatory retrofitting policy for charge stations. And
18 it needs to be smart, we need to show benefits.

19 But I don't see how we're going to support the
20 market right now given where the MUD building managers
21 are.

22 And Richard talked at length about the challenge
23 there. And I think the panel subsidies are a great idea
24 to upgrade that electrical capacity.

25 And this builds -- you know, one of the things

1 we need to do is take what we've learned and make sure
2 that it's embedded in the green building code,
3 improvements in the future.

4 So, rather than getting technology-specific,
5 focus those green building code improvements on where
6 the largest future fixed costs to expanding charge
7 station installations are, which are these panel
8 upgrades often.

9 And finally, just to -- you know, to sort of
10 build this out, we need to understand parking systems
11 much better than we do.

12 I know the CEC is an energy organization, but
13 this energy is going to be dispensed into a parking
14 space. And there's a real need, I think, if you talk to
15 the EVSTs to think creatively and understand the
16 opportunity space when it comes to existing parking.

17 So, let me just go on to the next slide so I'll
18 be short for time here.

19 This is obvious to, I think, all of us. We're
20 growing a market and we're growing a market, unlike the
21 vehicle market which really, literally did not exist
22 before.

23 And the supply-driven policies have not been
24 sensitive enough to current and future vehicle demand.
25 And so, we're observing stranded capital, but we're also

1 observing, as was discussed before, bunching of over-
2 utilization of stations.

3 And one of the things I would suggest is that to
4 try and shift this incentive towards thinking more
5 carefully about utilization, since we have a lot of
6 public stakeholders who aren't as revenue sensitive as
7 ChargePoint might be, that we think about creating a
8 two-part incentive where we subsidize or we create
9 incentives for the installation and the equipment, but
10 we also reward them for a certain up front level of
11 utilization when it's achieved. So that they get the
12 second sort of part of the payoff when utilization
13 occurs, you know, up to a certain threshold.

14 And I think that will encourage us to site
15 stations both where the costs are low and demand is
16 high. And I think we desperately need a dynamic
17 mechanism that creates an incentive.

18 So, the other thing I would suggest in the
19 context of auction revenues and SB 535, and other kinds
20 of capital being made available -- I know one of the
21 challenges that the CEC and other organizations face is
22 these annual budgeting and multi-year fixed budgeting.

23 Richard mentioned this, I think having a
24 revolving loan fund that provides favorable financing
25 for site hosts is potentially a way to create a pool of

1 capital that supports the growth of this infrastructure
2 market in a reasonable and sort of synchronized way,
3 rather than having to fight this battle on a year to
4 year basis.

5 The next slide, please. Getting all the way
6 down into the weeds, just to pick up on things that have
7 already been mentioned, one of the things that's
8 happening now is we don't have very efficient driver
9 access policy.

10 So, in Southern California, at least, over 50
11 percent of our publicly accessible charge stations are
12 not priced.

13 And what you see at a lot of those, if you look
14 at the utilization data, is it's congestion. And there
15 are a lot of ways to get access to this, and in which
16 this information could be submitted to you in grant
17 proposals to grow out those locations where there's
18 excess demand.

19 But the smartest way to both give drivers who
20 value charging access to charging is to price that
21 charging at a reasonable level.

22 So that those that are undertaking opportunistic
23 convenience charging, that don't really need that charge
24 to return home, make that space available for others.

25 And, you know, the innovations here are even

1 time-of-day pricing, which we do at parking meters all
2 over Los Angeles, now.

3 So that, again, we're providing access to those
4 that most desperately need that to return home. And
5 there are many limited-range vehicle drivers out there,
6 now, that fall into this category, like myself and I
7 think Richard.

8 Let's see, the other challenge that -- for
9 curbside charging and for MUDs is to allow for
10 scheduling of charging stations.

11 And I know that certain technologies allow that
12 and others don't. But I think that we need to provide
13 certainty around the charging opportunity for a lot of
14 individuals and scheduling, pre-paid scheduling is one
15 way to do that.

16 And finally, penalizing parking in stations when
17 there is not charging occurring.

18 Right now that's a city-by-city, I know,
19 regulation. But if there's a way to encourage that in
20 the grant applications for funding, I think that's
21 critical so that we can get more than one charge session
22 per station.

23 The next slide, please? All right, so I will
24 stop there. Thank you guys so much for working out the
25 technical difficulties and for having me. I've tried to

1 keep it focused and short. I'm happy to answer
2 questions, if there are any.

3 COMMISSIONER SCOTT: Well, thank you for that
4 terrific presentation and for giving us maybe your
5 slightly shorter version of it that you originally
6 intended.

7 It was really informative and so I do hope that
8 you will send us additional information to go into our
9 comments and to go into our record.

10 And sensing that I am the only person between
11 lunch, I will not ask you questions, but we might follow
12 up with you. Thank you.

13 MR. DE SHAZO: Thank you, bye-bye.

14 COMMISSIONER SCOTT: Bye. So --

15 MR. MC KINNEY: Okay -- oh, go ahead.

16 COMMISSIONER SCOTT: Go ahead, I'll let you.

17 MR. MC KINNEY: First of all, thank you very
18 much to this panel, just excellent information. You're
19 all real leaders in your industry, so thank you so much.

20 (Applause)

21 MR. MC KINNEY: So, Commissioner and to the IEPR
22 team, I'd like to propose that we stick to our restart
23 schedule at 1:30 and cut short our lunch hour a bit,
24 because I am concerned we may have speakers at the end
25 of today who have flights to catch, and may not be able

1 to stay longer.

2 So, does that work for everybody?

3 COMMISSIONER SCOTT: That's fine with me.

4 MR. MC KINNEY: Okay.

5 COMMISSIONER SCOTT: Okay.

6 MR. MC KINNEY: So, we'll reconvene at 1:30.

7 (Off the record)

8 MR. MC KINNEY: Good afternoon, I think we're
9 about ready to reconvene here. These will be the
10 afternoon panels for our second IEPR workshop,
11 Technology Over the Next Ten Years and Beyond.

12 This afternoon's panel, our first panel will be
13 on what we call ZEV and near-ZEV, or zero emission and
14 near zero emission truck technologies.

15 So, this includes electric drive, hydrogen fuel
16 cell drive, range extenders, hybrid packages, and
17 natural gas and all the different parts of that
18 technology pathway, as well.

19 I'm very pleased with the speakers that we have
20 for this panel. All of them are just extremely
21 knowledgeable about this part of the business and the
22 industry.

23 So, we have government, nonprofit and two
24 private sector representatives.

25 So, let me just review again, briefly, some of

1 our policy goals in this area from this morning's
2 presentation.

3 So, facilitate technology development and
4 commercialization of medium duty and heavy duty vehicles
5 for goods movement, freight technologies, and other
6 purposes.

7 Support the multiple near-term and long-term
8 technology pathways that I already mentioned.

9 And I also threw out some statistics on just the
10 disproportionate emission rates for particulates, carbon
11 and criteria emissions from the truck sector.

12 So, again, a fairly small amount of the fleet,
13 about three and a half percent total on a statewide
14 basis, but about 15 or 16 percent of the fuel use, all
15 of which is diesel or nearly all, and then up to 25
16 percent of the emissions from that.

17 So, we think this is a very promising area to
18 make investments.

19 Our key questions for this panel, so number one:
20 In advance of the pending 2023 federal regulatory NOx
21 requirements for truck emissions and the statewide SIPs,
22 or statewide implementation plans that will enforce
23 those, what level of market penetration and acceptance
24 do you think can be achieved through 2023 for ZEV and
25 near-ZEV trucks?

1 What key technology and cost challenges must be
2 surmounted?

3 And assuming that we can meet these cost and
4 technology challenges, what else needs to occur to spur
5 market demand and what tends to be a conservative and
6 very cost-conscious industry?

7 What specific -- how specifically would you
8 recommend that ARFVTP funding be used to overcome these
9 technology and market barriers?

10 Our first speaker will be Dr. Matt Miyasato from
11 the South Coast Air Quality Management District. And
12 Matt, you can either go from your desk or the podium.

13 Dr. Miyasato is Deputy Executive Officer for
14 Science Ethnecology Advancement at the South Coast AQMD.

15 He's responsible for their Technology
16 Advancement Office, Mobil Source Division, and
17 Monitoring and Laboratory Analyses Divisions.

18 He has a Master's and a Doctorate from the UCI
19 Advanced Power Energy Program.

20 And I am very pleased that Dr. Miyasato has come
21 up. He used to come up and beat us over the head,
22 asking for more money out of ARFVTP.

23 And now, it's turned into a true collaboration.
24 So, very much appreciate our partnership, Matt, and I
25 know we know each other well enough I can tease you.

1 So, we look forward to your presentation.

2 MR. MIYASATO: Well, thank you, Jim. Yeah,
3 that's all you had to do is just give the South Coast
4 its due share.

5 So, I want to thank Commissioner Scott for
6 inviting us to participate. I know Dr. Wallerstein
7 participated on the first IEPR Transportation panel and
8 I'm very pleased to be here at Jim's invitation.

9 What I thought would start my talk is briefly
10 summarize the challenges that we face, which Jim
11 mentioned, in terms of the requirements for NOx
12 reductions in order to meet the Federal SIP.

13 But first of all, the South Coast Basin, as many
14 of you may or may not know, but we're the greater L.A.
15 Region. We're the four counties of L.A., Orange, San
16 Bernardino, Riverside Counties, but we comprise about 44
17 percent of the State's population.

18 And on top of that, about 40 percent of the
19 goods that are imported into the United States come
20 through our region through the Port of L.A. and Long
21 Beach.

22 So, that's the sixth largest cargo gateway in
23 the world, so we're bearing the burden of a lot of goods
24 movement that comes into the rest of the nation and, for
25 that matter, the rest of the State.

1 If you look at the numbers, it's about 17
2 million residents, sixth largest cargo gateway, as I
3 mentioned, 10 million passenger drivers plus, and then
4 close to 2 million heavy duty trucks that traverse our
5 regional transportation system on a daily basis.

6 And so, all that conspires to give us the worst
7 air quality in the nation, and along with our sister
8 agency, the San Joaquin Valley, we suffer from extreme
9 nonattainment. That's a Federal word for not meeting
10 the ozone standard.

11 This is just an animated isopleth that shows you
12 through the course of the day, as the emissions go into
13 the air wrap at sunlight and it produces photochemical
14 oxygen or smog.

15 What you can see, as you look at a particularly
16 bad day in 2013, those two kind of balloon dots out
17 there in the Inland Empire, that's very unhealthy air
18 for everyone that's exposed to that air mass.

19 You also have a very large red mass out in the
20 Inland Empire, and also North L.A. County, and that's
21 unhealthy air.

22 But also, this orange color is USG, that's
23 unhealthy for sensitive groups. That's our children,
24 and the elderly, those that suffer from asthma or other
25 respiratory challenges.

1 And so that's a huge swath of the population so
2 this is really a health issue that we're grappling with
3 in our region.

4 If you look at the numbers, it's over 5,000
5 deaths per year that are estimated for not meeting the
6 Federal standards. And not only is it a health crisis,
7 it's also an economic crisis. So, billions of dollars
8 are lost in this region because of missed workdays,
9 hospitalizations, asthma cases, et cetera.

10 And as we dig in deeper to the health effects,
11 you know every day you look in the newspaper and you
12 look online and you're finding that air pollution also
13 has these very chronic or acute issues. So, the more we
14 look, the more we find.

15 So, here's just three recent headlines that new
16 research shows air pollution might make you bad at your
17 job.

18 It also can cause in utero effect, so exposure
19 by the mother can affect the IQ of a baby. This is
20 extremely troubling to those of us who live in Southern
21 California, who were exposed to some of these high
22 amounts of pollution.

23 And then, finally, this was a study about China,
24 but it could also affect fertility.

25 So, I mean it spans, again, to respiratory, it's

1 been linked to brain cancer, atherosclerosis, asthma,
2 but also these other kind of more nefarious factors.

3 And so when we dig deep to what are the bad
4 actors in terms of the NOx emissions from our region
5 that are then creating ozone and PM2.5. These are the
6 tons per day for this inventory.

7 This is in 2023. This is with all the
8 regulations in the book being implemented. You can see
9 the top sources are these traditional, heavy-duty diesel
10 conventional type technologies.

11 So, heavy-duty diesel trucks, off-road
12 equipment, marine vessels, locomotives.

13 The dash lines I show there in 2023 and 2032 is
14 where we need to be in terms of our inventory to meet
15 the Federal standards by 2023 and 2032. So, that's
16 about an order of magnitude of 70 to 90 percent
17 reduction we'd have to get from all these sectors in
18 order to meet healthy air requirements by the Federal
19 government.

20 So, again, that's 70 to 90 percent reduction in
21 these NOx emissions in order to meet the Federal
22 standards.

23 So, recognizing that the State, the California
24 Air Resources Board, the South Coast AQMD and San
25 Joaquin, they did a modeling exercise. We did this in

1 2012, where we looked at different scenarios that could
2 meet the 2050 greenhouse gas goals of the State, while
3 also picking up the Federal standards in 2023 and 2032.

4 And what they've developed are these scenarios
5 where you could meet those greenhouse gas goals. It was
6 a vision document.

7 And you can see by this, it's one scenario for
8 light duty, it really relied heavily on zero tailpipe
9 emission technologies, fuel cell, battery electric,
10 plug-in hybrid, all-electric range.

11 So, this allowed us to meet the 2050 goal, but
12 what it didn't state, explicitly, that you did not pick
13 up the 2023 and 2032 criteria pollutant goals.

14 And in fact, under this scenario every vehicle
15 sold in the State of California would need to be at zero
16 tailpipe emissions by 2040 in order to get the fleet
17 turnover by 2050.

18 But again, as I stated, it didn't meet the 2023
19 or 2032 ozone attainment goals. And in fact, you would
20 have to move that up by 10 to 15 years in order to meet
21 the South Coast goals.

22 So, you can imagine if we kind of projected that
23 to the South Coast Region, every vehicle sold in our
24 region by 2025ish would have to be zero tailpipe. So,
25 it just shows the magnitude of the challenge that we

1 face.

2 And a similar scenario was also produced for
3 heavy-duty vehicles and that's what I'll focus the
4 remainder of my remarks is you need to have, in order to
5 meet all of these combined goals, zero tailpipe
6 emission, or near-zero emission, or even plug-in hybrids
7 with all-electric range.

8 And that leads to this kind of conundrum or this
9 typical issue that you're facing and you're grabbling
10 with is what comes first? Is it the incentives? Is it
11 the market? Is it infrastructure? And we heard all of
12 that.

13 And so, rather than address those outright, what
14 I'd like to do is offer some examples and then perhaps
15 we can have a discussion about what some of those
16 examples may indeed provide as a policy and a ARFVTP
17 distribution.

18 So, back in the early 2000s when we knew the
19 2010 standards for heavy-duty trucks was coming up we
20 worked with the Energy Commission, we worked with the
21 Department of Energy and National Renewable Energy
22 Laboratory to develop the next generation of natural gas
23 engine to meet the .2 gram standard ahead of time or on
24 time. And in fact, we did meet the 2010 standard in
25 2007 with the 8.9 liter engine, the ISL-G. It's the

1 natural gas engine that's currently now in the market.

2 And also the 15 liter, the larger engine, the
3 HPDI was certified in 2010.

4 But having the foresight ahead of schedule to
5 develop these technologies then enabled us to have some
6 local success stories.

7 Now, this is in concert with the South Coast.
8 We have a limited mobile authority in our fleet rules.
9 But having a fleet rule where every public fleet of 15
10 vehicles or larger, when they purchase a new vehicle
11 they had to buy the cleanest technology available at
12 that time, natural gas.

13 But we've seen the fruits of that labor. LAMTA,
14 sixth largest -- or third largest transit agency in the
15 nation is completely natural gas, currently.

16 We see school buses, now -- we've actually
17 replaced over 1,000 pre-87 buses with natural gas.

18 And the refuse hauling market is going to
19 natural gas, as are other fleets because of the
20 economics. But we have been able to apply incentives,
21 as well as some regulatory backstop with our fleet
22 rules.

23 If we look to the -- so, that was back in 2010
24 and as we moved forward, but now, as I mentioned, we
25 have to get even larger NOx emission reductions.

1 So, as we look today and into the future we've
2 got to develop newer technologies that achieve this zero
3 or near-zero tailpipe emissions.

4 Thanks to the work at CALSTART, they developed
5 an H-Tough program. Hybrid trucks weren't in existence
6 eight years ago, but because of getting together with
7 the fleets and the economics of having a hybrid, there
8 are now close to a dozen manufacturers, over 130 miles
9 are now available.

10 And we're now looking at larger class sizes. As
11 opposed to just medium-duty, we're looking at Class 7,
12 Class 8 heavy-duty trucks.

13 We have programs with Volvo, Capstone and
14 Kenworth to develop plug-in hybrid electric vehicles.
15 It's a hybrid, it's going to be a large Chevy Volt, it's
16 got all-electric range. It plugs in to recharge the
17 battery and then operates as a hybrid when the battery's
18 discharged.

19 But also battery and fuel cell electric trucks.
20 This is working with the Energy Commission, as well as
21 the Department of Energy to deploy these Class A drayage
22 trucks.

23 Transpower is one of those providers. I know
24 Mike is here and will talk about his technologies.

25 But I noticed in Matt McClory's Toyota slides,

1 he had something that we also agree with, that the
2 technology meets to match the duty cycle. So, we look
3 at battery electrics as a short range, and then plug-in
4 hybrids with more wide scale adoption, and then
5 different fuels for longer range, such as fuel cells.

6 But we also think there's an opportunity for
7 wayside power. So, Dan Davids had that picture of a
8 Prius with a catenary. That's not far from the truth.
9 There's actually this catenary truck that operates in
10 Germany. We have a program underway, working with
11 Transpower and others, to develop a technology that
12 operates on and off a catenary, so it's a plug-in hybrid
13 using wayside power. And the Energy Commission is also
14 a strong partner in that program.

15 But again, hybridization with all-electric range
16 and zero emissions when it's on the corridor.

17 And then, finally, I'd be remiss if we didn't
18 acknowledge the economics associated with natural gas.
19 Fleets are converting to natural gas now because of the
20 favorable economics.

21 But what we'd like to have is a win/win, so you
22 have a technology that also produces extremely low
23 emissions, so what we call power plant equivalent, or
24 equivalent to an electric vehicle, but operating with a
25 combustion engine and so, again, working with the Energy

1 Commission and SoCal Gas.

2 On the technology providers, we recently awarded
3 contracts to two companies to develop that next
4 generation order of magnitude reduction, so .02 grams
5 for break horsepower NOx for these heavy-duty
6 applications. And so, we're very excited to see this
7 going forward.

8 So again, this is similar to what we did in the
9 early 2000s, we're trying to catch the lightning in a
10 bottle once again.

11 And so my last couple of slides, I just want to
12 impress upon the Commission I think what you're doing
13 here is excellent, and you're looking at both side.
14 You're looking at technology push and market pull and
15 that's, in fact, what we believe is necessary. You need
16 to be on both sides of that doorway, as it were.

17 We operate, typically, in the space of
18 technology push and we have the incentives with ARB and
19 others to have that market pull. And you need to
20 balance that, and I think what you're doing now is
21 looking at both the light-duty sector and the heavy-duty
22 sector and understanding that there's different needs in
23 each of those sectors of where the technology will
24 mature, anyway, and then you can apply your funds in
25 that manner.

1 So, I applaud you for doing that and taking a
2 real hard look at how that occurs.

3 The final slide is really the lessons learned
4 that we've been able to at least comply on the most
5 recent history is if you have some regulatory backstop,
6 or a time at which the regulation's going to take place,
7 offer incentives to help the end-users comply with that.

8 So, good examples are the CARB regulations for
9 zero emission vehicles, with their Hybrid Voucher
10 Incentive Program, the CVRP.

11 We saw a good example with the Port Clean Truck
12 Program. The ports actually came in ahead of ARB and
13 said any truck into the port complex has to be 2007 or
14 newer.

15 We added to that proposition 1B funding, as well
16 as DOE, CEC, EPA funding and helped incentivize natural
17 gas trucks in that application, and was widely
18 successful.

19 And so we think having this so-called three-
20 legged stool, you have the technology, you have an
21 incentive program and then you have a policy that backs
22 that up.

23 And so, the last bullet on this is simply saying
24 that the policies that are in place under the Regional
25 Transportation Plan, the I710 expansion, the Vision

1 Exercise, the ZEV Action Plan, the AQIP Funding that the
2 ARB just put out showing that there is a strong
3 leadership of the State to develop these zero emission
4 technologies really helps to incentivize the market and
5 ensure that the providers are actually going to provide
6 or engage with us to provide these technologies because
7 it's so desperately needed, especially in areas such as
8 the South Coast.

9 So with that, I'm going to conclude my remarks
10 and look forward to the rest of the panel.

11 MR. MC KINNEY: We want you to stay up there at
12 the podium for a minute.

13 Did you have any questions or follow-up
14 comments, Commissioner?

15 COMMISSIONER SCOTT: I did not on this. This
16 one is great. Thank you so much for a terrific
17 presentation. And I would just echo what you said in
18 that we really appreciate the collaboration and the
19 partnership that the South Coast and the Energy
20 Commission have to help continue to advance these.

21 And I think our theme in the morning was how
22 important it is to continue to accelerate this.

23 MR. MIYASATO: Absolutely.

24 COMMISSIONER SCOTT: And your presentation picks
25 that up very well, too, when we look at the 2050 goals

1 and how that doesn't help meet the attainment goals in
2 2023 and 2032, so thank you.

3 MR. MC KINNEY: Yeah, Matt, and if I could ask a
4 follow-up question?

5 So, we have, you know, kind of a larger size
6 solicitation that will be coming up for a medium-
7 duty/heavy-duty advanced technology packages. We have,
8 I think, a lot of the AARB team here this afternoon from
9 HFIP and then from the Cap and Trade Proceeds.

10 In your view, and if you can't answer this now
11 that's fine, we could take, you know, kind of written
12 comment later.

13 But the things we're touching on at the end,
14 where we've still got kind of some basic technology
15 development work to do, and then we've also got more
16 technology, say, in the medium-duty sector that are
17 really hitting commercialization, but they still boosts
18 to get them out in the market and get them widespread.

19 Do you have a sense for what the right balance
20 should be between continuing that basic technology
21 development versus really moving the market where those
22 technologies are mature?

23 MR. MIYASATO: I probably don't want to get
24 pinned down to a percentage. But I think what you do
25 through your investment plan and you actually vet with

1 stakeholders, and you have staff look at the state of
2 technology, as it were, in terms of how many vendors are
3 providing products I think that's a good process.

4 Because, as I was alluding to, it's different
5 for every technology, every fuel and I think you just
6 need to evaluate it on a case-by-case basis.

7 Something that I really liked, the AQIP report
8 that was just recently by ARB, is they have that nice
9 graph that shows pre-commercialization, early
10 commercialization and then market penetration, and that
11 continuum and then where the incentives may or may not
12 fall off.

13 I think it's a good concept, but it's not as cut
14 and dried as that. You have to actually dig in and look
15 at every duty cycle and every technology, and that's
16 what we would encourage you to continue to do.

17 MR. MC KINNEY: Okay, thank you.

18 I'd like to introduce our next speaker, So John
19 Boesel is the founder of CALSTART, which is unique and
20 really does first rate work in terms of road mapping for
21 the medium-duty/heavy-duty vehicle and truck sector in
22 California and now nationwide.

23 They did the CalHEAT Roadmap through Energy
24 Commission funding for us, and have just continued to
25 identify and compile really first rate technology

1 demonstration teams for our funding programs and for
2 others.

3 So, John welcome and we look forward to your
4 remarks.

5 MR. BOESEL: Great, thank you, Jim and thank
6 you, Commissioner Scott for this wonderful opportunity.

7 Just a good opening slide to help put heavy-duty
8 vehicles against heavy-duty vehicles in context; in this
9 case the technology selected is hybrid in showing, in
10 each of these cases, how one hybrid truck provides the
11 equivalent of X number of hybrid cars.

12 Because these bigger vehicles consume a lot of
13 fuel and so if we can convert them, we can have very
14 significant impacts.

15 You could do a very similar slide for natural
16 gas, and electric, and fuel cells as well.

17 But it just goes to show how important this
18 sector is. And currently, we do have a very aggressive
19 set of regulations driving down the carbon emissions in
20 the light-duty vehicle sector, driven by the Obama
21 Administration, and with the CARB's EEV Program.

22 And as we see those policies move forward, this
23 sector will become even more important and represent a
24 larger percent of emissions from transportation overall
25 so, clearly, some very significant benefits from

1 investing in this sector.

2 Jim asked me in this scale to specifically focus
3 a bit on our I-710 work. And so just to make clear,
4 everybody understands this is from the ports down here
5 in L.A., Long Beach, up to the rail yards in East L.A.,
6 about a 20-mile stretch of highway that's heavily
7 congested and heavily polluted.

8 And we have been, now, under contract for about
9 three years working with Metro and the Gateway Council
10 of Governments evaluating opportunities because they --
11 the port definitely wants to expand traffic along that
12 corridor because it's so crowded, and they want to
13 expand the port, but the South Coast Air District
14 rightly said we can't let you generate more emissions
15 because we're already in nonattainment.

16 So, we've been helping them to examine is it
17 possible to generate zero emission traffic, truck
18 traffic in this region, allowing the port to expand, but
19 then not impacting the criteria emission sector.

20 And one of the things we have learned is that it
21 is really not so much a corridor as a zone through our
22 analysis, because these dots -- and there's a key here
23 you can see.

24 But, basically, if you look at these
25 concentrations over here -- I don't know how well my

1 pointer's showing up, maybe I need a new battery.

2 But in these various concentrations of the dots,
3 these are distribution centers and places where the
4 trucks actually go.

5 So, it's necessarily right along the I-710
6 corridor, but it's in the region. So, what we really
7 want is zero emission traffic in that region to really
8 help the residents.

9 And so, what we have done and there's a
10 published report that's publicly available, we have
11 identified four leading options that could help the
12 ports and the region attain its goals.

13 Because a lot of people said zero emission
14 trucks, you know, when you get that big it's just not
15 possible. You know, it works for a Nissan Leaf, or a
16 Tesla, but not in big trucks.

17 Well, in fact, we've done an extensive analysis
18 and interviews with manufacturers, suppliers and there's
19 a lot of really good work being done.

20 So, there are four options that we think really
21 have viability that would really benefit from continued
22 State and Federal investment in this sector.

23 One is, basically -- and Matt touched on this as
24 well, is basically a Chevy Volt type system, a range-
25 extended electric vehicle, using that in the truck

1 format. And there is currently a prototype underway
2 that is being tested out in that configuration.

3 So, it would allow you, basically, a limited --
4 a limited number of miles, all electric, and then you
5 more or less go into what we normally would call a
6 hybrid mode, but still actually in the Volt
7 configuration, you're still operating under electric
8 drive.

9 And then the next option is the pure battery
10 electric vehicle and we'll hear about that from Mike
11 Simon. A truck that on a fixed route, going back and
12 forth can operate quite easily with rapid charging or
13 possibly battery replacement, and provide you the Nissan
14 Leaf equivalent experience.

15 And then there's the fuel cell range-extended
16 electric vehicle, which is somewhat how like the Honda
17 Clarity is designed.

18 Basically, the fuel cell is helping to keep the
19 batteries charged and continuing to provide electric
20 power throughout continuous operation in the day.

21 And then you have the plug-in hybrid electric
22 vehicle that's more similar to how the Ford Fusion
23 Energi is designed and operates.

24 So, those are four options that we think are out
25 there that could be developed and we could see come to

1 the market. So, what we need are the right set of
2 standards and investment, public investment to really
3 help drive this forward.

4 I want to just say, talk just quickly here on
5 the bus/truck connection. We have, on the picture of
6 the bus on top, that was an Energy Commission funding,
7 coming from CALSTART, one of our ten projects that we're
8 operating for the Energy Commission, and we're very
9 happy to have that grant to do so.

10 But these were the -- we were able to purchase
11 two Proterra zero emission electric buses. They were the
12 first electric buses put into revenue service in the
13 heavily polluted San Joaquin Valley.

14 And right now the San Joaquin RTV is having
15 really a good experience with these buses and we're
16 working with them to procure more with Federal funding.

17 So, this is an example where the Energy
18 Commission invested in bus technology and it's really
19 helping to have an impact.

20 And what we have really seen is, basically, that
21 the transit market is the early adopter segment in
22 advanced heavy-duty vehicle technology.

23 We saw it with hybrid buses starting out in
24 prototypes. And in fact, when Mike Simon, in his
25 previous company developed some of those early hybrid

1 buses, prototypes, they got into the tens, hundreds and
2 then eventually over a thousand buses being sold in a
3 year in the transit sector.

4 And so, that was sort of starting in the early
5 to mid-90s and carrying through the middle of the last
6 century -- or the last decade, sorry.

7 And then we started to see, once that technology
8 got proven out, move into the truck market which is an
9 order of magnitude larger than the bus market.

10 And you can see that basically a very similar
11 set of curves with natural gas with -- in part due to
12 really good leadership of the South Coast AQMD, funding
13 from the Air District, from DOE, and the Energy
14 Commission in the early 90s, you helped develop a heavy-
15 duty natural gas engine that then became viable, allowed
16 for the fleet rules, allowed for natural gas to be the
17 dominant fuel in the California transit market.

18 And that's amazing that we can say that now.
19 And now we're starting to see heavy-duty natural gas
20 engines proliferate in the trucking industry.

21 But it wouldn't have happened, I would suggest
22 that we really wouldn't -- we wouldn't be seeing the
23 progress we are in the truck market today without
24 transit playing a key role.

25 And sometimes we say, well, transit is CARB's

1 sphere of influence, the Z-bus rule. But I would say
2 this is a great area of collaboration and cooperation
3 between the Energy Commission and the Air Resources
4 Board.

5 So, right now, you know, why aren't we seeing
6 more advanced trucks and buses?

7 The technology is still pretty new. Well, in
8 this case, the light-duty market is actually quite far
9 ahead. It generally does tend to be still too
10 expensive. And we haven't yet quite seen the
11 investments moving along as fast as we'd like.

12 And then, frankly, also the standards at the
13 Federal level are not as aggressive as they are in the
14 light-duty market.

15 They're not forcing technology as much as we'd
16 like to see.

17 Now, however, we're right now working with EPA
18 and MITSA (phonetic), and sometime next year there will
19 be a second set of standards for the medium and heavy-
20 duty vehicle sector.

21 And we think there's an opportunity for those
22 standards to encourage more technology development and
23 more investment and innovation in this sector, and we're
24 working to help make that happen.

25 And so, I want to answer Jim's questions that he

1 posed, what can the State do?

2 One is to just remember that we are leading the
3 nation, if not many parts of the world, in our response
4 to the climate threat. And simply staying the course
5 with the Low Carbon Fuel Standards, the Cap and Trade
6 Program is hugely important, and I really urge the State
7 to do that.

8 And then I think, you know, the effort that
9 the -- with the Air Resources Board and the Energy
10 Commission, CPUC all working together to really help
11 promote this industry is important.

12 And then more specifically, for the CEC and the,
13 I'll call it the AB 118 program because I can't remember
14 all the letters in the acronym, but is really, I think,
15 continuing to invest in technology development.

16 Helping us move from that prototype to the pre-
17 production phase is really important. And it's really
18 critical, of the 150 CALSTART members, we have six
19 light-duty car companies, but we've got a lot of players
20 in the medium and heavy-duty vehicle space.

21 The car companies tend to have their own major
22 R&D centers. The government funding doesn't do a lot to
23 help develop that technology for that sector.

24 But the truck companies tend to be integrators.
25 They don't have large R&D centers. So, public funding

1 on the technology and development side can have a much
2 more significant and beneficial impact and we've already
3 seen that happen. We wouldn't have natural gas buses
4 and trucks today without government funding. The same
5 with hybrids and I'd say the same with electrics.

6 So I'd say continue to invest in technology
7 development funding.

8 And I know the ARB is talking about a very
9 significant increase with Cap and Trade funding for this
10 area as well.

11 Then we not only want to develop the prototypes,
12 but these large pilot deployments, whether they're 10s,
13 20s, 50s, and that will really help move the industry
14 forward, there's a lot of fleet learning.

15 And then at the same time I think continuing to
16 provide the incentives through the HVIP program. The
17 CEC has a natural gas program that -- a natural gas
18 truck purchase program that's very helpful.

19 You may want to consider using more of a voucher
20 model to help provide those incentives. But I think
21 providing those purchase incentives concurrently is
22 really critical.

23 So, I think that's the second to the last slide.
24 And the last slide is I want to also just touch on the
25 opportunity for natural gas. We did, under the CalHEAT

1 Roadmap that Jim referred to, we did do a lot of work on
2 the real upside for natural gas. We have technology
3 today that's quite good but it can be better. We
4 shouldn't think of natural gas as a stagnant technology.
5 There's a lot to be done to improve the efficiency and
6 lower the carbon emissions from natural gas.

7 And just some numbers here about, you know, how
8 that fuel could be used in the Class A truck and bus
9 market. We are now -- it's very exciting to see an
10 expansion of engine sizes coming available.

11 And I think when we look at policies to really
12 help us integrate renewable natural gas with fossil
13 natural gas it is a great way to really increase -- or
14 decrease carbon emissions.

15 And then, also, longer-term if you look at
16 studies done by Stanford and elsewhere, if an engine was
17 optimized to run on natural gas, versus taking a diesel
18 engine like we have today and kind of modifying it to
19 run on natural gas, we could see very significant
20 improvement in efficiency.

21 And that's a large area of investment, but there
22 really is a huge opportunity that hasn't yet been
23 leveraged.

24 So, Jim, that concludes my presentation and I'm
25 happy to answer any questions.

1 MR. MC KINNEY: Great, thank you very much,
2 John, very informative as always. I don't have any
3 immediate questions.

4 Commissioner?

5 COMMISSIONER SCOTT: Sure, I had a couple
6 questions. Thank you, John, for that great
7 presentation.

8 So, you talked at the end of your presentation
9 about what can the State do? And I would ask you, also,
10 in terms of the money, so the Alternative and Renewable
11 Fuel and Vehicle Technology Program, and you're right we
12 definitely need a better acronym for that.

13 You know, we've got up to \$100 million a year
14 that we could spend. And that's a lot of money, but
15 it's not probably enough to really accelerate this
16 market the way we've been talking about here around the
17 room today.

18 And so, I'm wondering what ideas you have about
19 how you can -- or if you have ideas if there's places
20 where we can strategically invest that money that it
21 would really help leverage additional funds, or a great
22 portion of additional funds to continue helping with
23 this transformation?

24 MR. BOESEL: Yeah, well, I would say that
25 actually those funds -- I realize there are a lot of

1 demands on those funds and they're used in a lot of
2 different ways.

3 But I would say that they have already had a
4 pretty good impact and they can continue to have a
5 significant impact.

6 And I think looking at opportunities to leverage
7 it and match it with Air District funding, other funding
8 is really important.

9 I think those four technologies I laid out for
10 the I-710 they're really worth investing in.

11 And then in the CalHEAT Roadmap, we also
12 identified some opportunities that perhaps might be more
13 appropriate to the San Joaquin Valley.

14 Because you don't have -- in the South Coast, in
15 that one very heavily concentrated region you have a
16 need for this zero emission capability, 30, 40 miles of
17 zero emission capability.

18 The San Joaquin Valley is long. A lot of those
19 trucks are just doing long-haul. And so there are some
20 other opportunities I think that we ought to be looking
21 at, natural gas hybrids and others that were detailed in
22 the CalHEAT Roadmap that are really worth examining.

23 And then, Commissioner, I did just realize there
24 was one other point I wanted to add, and that is that
25 the Energy Commission does have a block grant authority

1 established under the AB 118 program that really does
2 allow the Energy Commission to leverage and make use of
3 the incredible expertise here in California in this
4 sector, in the advanced medium and heavy-duty vehicle
5 sector.

6 And I think the Energy Commission could use that
7 block grant authority to more efficiently leverage those
8 resources. And you've got a staff that's pretty over-
9 burdened, I'd say at this point, and constrained.

10 And if that block -- making full use of the
11 block grant authority under AB 118 and extended through
12 AB 8 would really allow, I think, the Energy Commission
13 to do more with its investment.

14 COMMISSIONER SCOTT: And then two more things.
15 One was the technology, the four different technology
16 options that you laid out, and you mentioned that those
17 are in a report. And so I just wanted to make sure you
18 make sure we get a copy of that report, and that it goes
19 into the docket and all of that, that would be great.

20 MR. BOESEL: Very happy to do that.

21 COMMISSIONER SCOTT: And then the last question
22 I had for you, you talked a lot about the bus/truck
23 connection and you had a great slide about how the
24 technology starts in the buses and then it sort of makes
25 its way through.

1 And do you have more data, or background or
2 studies on that that you could share with us, as well?

3 MR. BOESEL: I believe we can pull that
4 together. And I forgot the little yellow category there
5 on the far right, which is the non-road sector. We
6 now -- another Energy Commission project that we're
7 managing is with Caterpillar and using a -- developing a
8 hybrid excavator. So, now, we're seeing that technology
9 go to the non-road sector as well, which is really
10 exciting.

11 And, yeah, we do have some additional
12 information that we can pull together. But this is --
13 and, actually, I think the South Coast has done a really
14 good job, Barry Wallerstein has done a great job in
15 several presentations of basically taking this same
16 slide and telling the natural gas story, and how that
17 investment has really helped.

18 COMMISSIONER SCOTT: Yeah, that's great, and I
19 was thinking a lot because when I looked at the map, the
20 slide you had and it's got all of the different types of
21 vehicle technologies that we need to address to get to
22 the goals, it's --

23 MR. BOESEL: Yeah, and just to elaborate on why
24 is this the case, and one is that you've got a
25 subsidized purchasing system in the transit market. The

1 Feds buy 80 percent, currently 80 percent of a transit
2 bus.

3 And we're actually, now the Congress is
4 considering the next Federal Transportation Bill, which
5 dictates how gas tax revenues are spent. And we're
6 recommending that they develop a more performance-based
7 funding formula.

8 So that for a diesel bus today it would be 80
9 percent. But as you get cleaner and closer to zero and
10 lower carbon, perhaps that percentage could go all the
11 way up to 100 percent.

12 And so you've got the Federal, the subsidized
13 purchasing system. You also have public bodies, the
14 boards of transit properties also want to do the thing
15 that's right, not necessarily the thing that makes the
16 most sense for the bottom line.

17 But if they do a better job of balancing that, I
18 think, that private sector entities.

19 So that's why transit, you know, really does
20 play a key role here.

21 And then it makes the truck manufacturers and
22 others more confident in the technology, the fleet's
23 more willing to take that risk and try a new technology
24 once they've seen it work in the bus sector.

25 MR. MC KINNEY: Yeah, John, actually I do have a

1 follow-up question and then we'll go to Mike.

2 I want to ask you the similar question that I
3 asked to Matt Miyasato. So, again in our ARFVTP
4 portfolio we've got three or four very successful
5 medium-duty electric drive companies, so Electric
6 Vehicles International, Boulder Electric, Motive Power
7 and Right Speed, as well.

8 They've got good products that are coming in
9 commercial phase, which means that they're eligible for
10 the HVIP funding, but perhaps there's more technology
11 development from our program.

12 And then I think there's still some pretty heavy
13 lifting to do, no pun intended, on the truck, the heavy-
14 duty side for just basic technology development, whether
15 it's electric drive, fuel cells, or natural gas.

16 Do you and CALSTART have a sense for what kind
17 of the right balance should be between, you know, as we
18 think about how to invest our funds, and as the ARB
19 considers how to invest their new funding in this
20 sector?

21 MR. BOESEL: Well, yeah, I guess at the end of
22 the day it will depend on how much money are we talking
23 about? And then once we have a total sense I'd be able
24 to give a better answer to that.

25 But I think there's, you know, clearly a need

1 for the incentives to get vehicles that have been
2 developed and help those, the companies like EVI, and
3 Smith and others, and Hino get those trucks out into the
4 market, and we need to continue those incentives.

5 I'd say right now we're probably under -- we're
6 not providing enough incentives for the pure electric
7 trucks. And the more that -- if we could provide a
8 little higher level of incentive for those that would be
9 good.

10 And so I think, you know, you really kind of
11 look -- you need to look at the total amount of dollars
12 available.

13 But if you look at between the CEC, the natural
14 gas bucket for incentives, the HVIP program, you know, I
15 think right now and in the next couple of years, \$30
16 million, \$40 million a year if you looked at all that
17 combined is the right amount.

18 And then we need to be investing in developing
19 this next generation of technology. And there are lots
20 of demands and opportunities there.

21 And so, yeah, you could easily go another \$30
22 million, \$40 million a year in that sector.

23 MR. MC KINNEY: Great, thank you.

24 And Matt, you had a question or a comment?

25 MR. MIYASATO: Just a comment, I wanted to

1 highlight and agree with John's comment about
2 specific -- or the specific recommendation that,
3 Commissioner Scott, you'd asked about, the ARFTVP
4 program.

5 So, a good example is a block grant, but also
6 leveraging existing program infrastructure. So, what
7 you were able to do is used South Coast to administer
8 some Energy Commission hydrogen funding, which we were
9 able to jointly then decide on which stations should be
10 funded. And I thought that worked rather well in terms
11 of getting the funds expended and encumbered.

12 The second comment, Jim, is just more
13 specifically on what you asked John about the balance
14 between heavy-duty and medium-duty. I guess if you're
15 going to pose the question to the South Coast, it's
16 really heavy-duty.

17 But we have to be careful and that's what I was
18 trying to caution Mike on previously is we have to look
19 at the duty cycle. It's really duty cycle dependent.
20 So, you have to look at where they make sense. Again,
21 with Toyota's line, BEVs for short haul, wayside power
22 for longer regions, plug-in hybrids for short hauls and
23 near dock, and things of that nature.

24 So, really be careful on duty cycle specific,
25 matching technologies with the appropriate duty cycle.

1 MR. MC KINNEY: Great, thank you very much,
2 John.

3 MR. BOESEL: Thank you, Jim. Thanks
4 Commissioner.

5 MR. MC KINNEY: I would like to introduce as our
6 next speaker Mr. Michael Simon, who's the founder and
7 CEO of TransPower, whose mission is to develop and
8 provide advanced power technologies that reduce fuel
9 consumption and improve the department.

10 I'm going to take a few liberties with your
11 biography here, Mike.

12 Mike is one of our grantees and I think is
13 rather heroically working to develop a commercially
14 viable all-electric Class A electric tractor.

15 And as I read through his background, this is
16 kind of classic California perseverance and innovation,
17 somebody who had a long career in the aerospace
18 industry, good credentials out of Stanford's Engineering
19 Program, and then found himself in a whole new
20 technology sphere and marketplace.

21 And is really working, again, to develop
22 something that, pun intended this time, is a very heavy
23 lift to move 80,000 pounds of cargo with an all-electric
24 battery platform.

25 So, Mike, we look forward to your presentation.

1 MR. SIMON: Well, thank you. Thank you, Jim,
2 for that very generous introduction. It's not every day
3 I'm called a hero, but I'll accept it.

4 And thank you, Commissioner Scott. And if you
5 would, please give my regards to Commissioner Peterman,
6 if you are still in touch with her, please.

7 And thanks to the rest of you for giving me the
8 opportunity to share some of TransPower's recent
9 experiences with you.

10 This is -- I only have seven slides, including
11 this title slide, and this is the only one, actually,
12 that shows any -- that shows vehicles.

13 And what you see, the vehicle to the left
14 where -- the small shot, I'm posing with Mayor Garcetti
15 and our Chief Science Officer, Jim Burns. And then
16 another larger shot of it showing it being recharged
17 with a plug. That's the first our electric drayage
18 trucks. It's been operating up in Los Angeles and it's
19 hauled 75,000 pounds over to Vincent Thomas Bridge.

20 And showing, you know, fairly good reliability
21 and fairly good energy efficiency.

22 And we have seven more trucks of that basic
23 design on the way that will be deployed this year.

24 The vehicle to the right is a yard tracker that
25 you see in the process of pulling 100,000 pounds. And

1 we're building three of those, two for the Port of Los
2 Angeles and one for IKEA, all supported with public
3 funding for which we're extremely grateful, the two port
4 tractors funded by the Air Resources Board.

5 The drayage trucks are funded primarily by the
6 California Energy Commission presently, so we're very
7 grateful for that support, as well as AQMD, and the
8 Department of Energy, and the ports themselves.

9 So, this is a really a great team effort. The
10 reason I wanted to talk about the vehicles for just a
11 moment is one of the core philosophies that has guided
12 our business and that I think should play a role in your
13 investment planning is that we're trying to develop
14 components that can be used across all vehicle platforms
15 or multiple vehicle platforms.

16 And it sounds easier than it is because there
17 are so many different truck and bus models out there in
18 the medium and heavy-duty sector, and there are so many
19 differences between these vehicles that any time you try
20 to convert one to electric or hybrid electric propulsion
21 you -- each new vehicle is a brand-new R&D project to
22 make a system work.

23 The vehicles have complex control systems, as
24 well as different physical geometries.

25 And so you end up designing some custom hardware

1 and some custom software that's tailored to every single
2 vehicle model.

3 So, that's one thing you should recognize
4 because, you know, the money you spent over the last two
5 or three years may have gotten five or ten vehicle
6 models electrified, but there may be 80 or 90 other
7 vehicle models that still need to be electrified. And
8 even though the components have been funded and the core
9 technology have been funded you still won't get them
10 into those other vehicles unless there's some support
11 for converting the other vehicles.

12 So, understanding that there are a lot of
13 vehicle models that have to -- that each of which
14 requires its own investment is an important point, I
15 think.

16 But having said that, what we're trying to do is
17 minimize that new investment that has to be made in each
18 new vehicle by developing a suite of core technologies
19 and core components that are cross-cutting, that are
20 very versatile and that can be used in multiple types of
21 vehicles.

22 And the rest of my presentation is going to
23 focus on those particular technologies and our view on
24 what additional funding and what additional support
25 would have the most benefit in terms of moving those

1 technologies forward that can then be -- pay dividends
2 by being deployed in multiple vehicles.

3 One last point I'd like to make is while the
4 vehicles you see here are battery electric vehicles and
5 that's what we're best known for right now, we also have
6 built and are building hybrid vehicles.

7 We do believe very strongly that there's a
8 prominent role for hybrid vehicles, particularly plug-in
9 hybrid vehicles with large battery pack sin the medium
10 and heavy-duty truck sector, and the school bus and
11 transit bus sector.

12 But every hybrid vehicle is only as good as the
13 electric vehicle that it's built on. You know, there's
14 a core. So, again, the core, the electric technologies
15 I'm talking about not only are cross-cutting
16 technologies across vehicle platforms, but they're also
17 cross-cutting technologies vertically across different
18 technologies.

19 Because if you have a really good battery pack,
20 you have a really good motor, you have a really good
21 transmission, if you have a really good core electric
22 vehicle control system, those same basic components can
23 be used in diesel hybrid, gasoline hybrid, natural gas
24 hybrid and even fuel cell vehicles.

25 So, you really get a great multiple path to get

1 paid back for investing these technologies.

2 That's of interest to you as a government agency
3 because you obviously want the most leverage and the
4 greatest impact. And it's of the greatest interest to
5 us because that gives us the maximum revenue and profit
6 when we go into the commercial phases.

7 So, it also lets us vertically integrate our own
8 company. What's shown here is our -- and this is really
9 the only infomercial chart for TransPower.

10 But we do business basically at three levels.
11 We develop our own components. Some are more
12 organically developed in-house, some are adaptations of
13 other people's components.

14 For example, the lower center photo is a picture
15 of our main propulsion system that it's now standardized
16 across all of our vehicles. And the silver disk you see
17 at the bottom of that photo is an electric drive motor.

18 And if you could zoom in on the motor, you'd see
19 the word "Fisker" emblazoned on it. That motor was
20 actually designed for the Fisker Karma Hybrid Car.

21 And, you know, it was an embarrassment to the
22 Obama Administration and others when Fisker went out of
23 business a year or two ago, but their technology lives
24 on.

25 And that's another thing to remember is that

1 companies may come and go, but the assets of those
2 companies find second, and third, and fourth lives, so
3 the investments are never wasted.

4 And we've taken this Fisker motor and mating it
5 to an Eaton transmission that has a unique computer-
6 controlled shifting ability, we have a propulsion system
7 that can move 80,000 pounds using a motor that was
8 designed for a 4,000-pound car. And so far it's working
9 very well.

10 So, we integrate components and we take these
11 components and we build them up into what we call
12 subsystems.

13 Right now there are three main subsystems that
14 we install in our vehicle. I know there are four listed
15 in the center box, but we've combined the vehicle
16 control and electrically-driven accessory subsystems
17 into one. That's the center photo you see there and
18 I'll talk a little bit more about that type of
19 technology, but the other two being energy storage
20 motive drive.

21 And we maintain that you have a really good
22 solid technology base in these three subsystem areas you
23 can build on that in many different ways, with hybrids,
24 fuel cells, garbage trucks, you know, drayage trucks,
25 school buses.

1 We have an electric school bus using the exact
2 same components. It just finished -- today is its one-
3 month anniversary of carrying kids at the Escondido
4 Union High School District, a 40-foot school bus funded
5 by the ARB, also, thank you very much, so a lot of
6 versatility.

7 And then, finally, we can integrate these
8 systems into total vehicle systems. That's the top
9 level of our business.

10 And if I haven't given you enough sort of flavor
11 for how versatile these technologies are and how many
12 different applicants there are, there are applications
13 that don't even go in vehicles.

14 And what you see here on the right is a battery
15 subsystem on a rack that's designed not to go in a
16 vehicle, but to be a stationary energy storage system.
17 And this was actually -- this research was initially
18 funded by the PIER Program, again the California Energy
19 Commission playing a leadership role here in stationary
20 energy storage.

21 And we've already got a commercial sale for a
22 system like this from New York City Transit. And this
23 summer we're going to be installing an almost one-
24 megawatt hour system, 800 kilowatt hours to be exact, on
25 West 53rd Street in Manhattan, at a major substation,

1 and it's going to provide -- basically, turn the New
2 York Subway system into a giant -- into the world's
3 largest Toyota Prius by absorbing energy from the subway
4 train as they brake.

5 This was all -- all of this was funded by the
6 California Energy Commission, and the EQMD, and the ARB,
7 and the folks in this room.

8 So, you're having a huge impact. It's just
9 we're not very good with all the resources, really, to
10 go out and get a lot of PR.

11 You might have heard about the Wal-Mart Wave
12 hybrid truck that was -- I don't know how many of you
13 heard about that, Wal-Mart put a Wave truck out of here,
14 we built it for them, along with Capstone. We're the
15 ones that integrated that truck, so a lot of exciting
16 possibilities here.

17 So, now shifting more to just the generic
18 magnitude of what we're talking about, this slide here,
19 I was able to find some recent statistics on the number
20 of Class 6, 7 and 8 trucks sold. These are new factory
21 orders for trucks last year.

22 And with even just one out of eight vehicles
23 adopting electric propulsion technologies, we project
24 that this could be a \$6 billion market, and that's the
25 message of that.

1 And these are just ball park estimates of the
2 number of annual sales of different types of trucks that
3 might be possible using electric propulsion within, you
4 know, the time frame we're talking about, 2020 to 2030.

5 Some of these numbers I think might be
6 conservative of 2,000 port trucks. There's over 10,000
7 just operating in the Ports of L.A. and Long Beach,
8 alone. So, 2,000 in terms of nationwide might be
9 actually a conservative estimate. But you can see this
10 is potentially very big business.

11 The basic products that we build that require
12 technologies are listed here. Every electric or hybrid
13 electric vehicle requires some version of these. These
14 just happen to be our versions of them that are shown
15 here.

16 But most electric and hybrid vehicle makers now
17 are using lithium ion batteries of different types.

18 We have gone through several generations of
19 battery packaging schemes trying to come up with the
20 most robust and beneficial way to integrate batteries,
21 and develop the battery management systems.

22 Those are areas that future research can have a
23 high payoff helping to configure different types of
24 energy storage systems.

25 We don't need a major charging network or

1 charging infrastructure because one of the unique
2 approaches we've taken is to put the charger on the
3 vehicle.

4 And the charger you see here, the far right
5 photo that's the inside of what we call an inverter
6 charger unit because that charger also controls the
7 drive motor.

8 It charges the battery pack at a 70-kilowatt
9 rate, which makes it actually more powerful than a
10 typical type three charger, level three charger and it's
11 on the vehicle.

12 As we were talking about chargers this morning I
13 was thinking that with the right investment maybe that
14 thing could be shrunk down. And I know some of the
15 external charger manufacturers probably don't want to
16 hear about this, but if you shrunk that thing down and
17 got the cost down low enough, you could put something
18 like that in the trunk of every Nissan Leaf and you
19 wouldn't need to put charging stations all over the
20 State, you would just need to put a plug and a cable.

21 I can't say for sure whether the cost to get
22 down low enough to do that, but I think it's something
23 worth looking at because it could really speed adoption
24 of vehicles if people didn't have to go hunting around
25 for chargers and only had to find special outlets which,

1 instead of costing \$50,000 or \$100,000 per vehicle, it
2 might cost you \$2,000 or \$3,000 for just the cable and
3 the plug, so just a wild idea to throw out there.

4 You know, main propulsion is another area that
5 always uses it, is always a key technology core,
6 technologies in three types of vehicles. I mentioned
7 how we do that with the Fisker motor.

8 Electrically-driven accessories are the devices
9 of power, power steering, power braking.

10 And then, of course, you need a control system
11 to regulate when battery power is used, especially when
12 you get to the complexity of hybrids.

13 Some of the key specific technology challenges
14 that we believe require future funding and that should
15 be addressed in future programs are shown here, so this
16 is probably the most important slide in terms of the
17 specific goals of the reasons I'm here.

18 Energy storage for these larger vehicles,
19 keeping the cells in balance is very important. We use
20 very large cells so we don't have to worry about
21 balancing too many of them.

22 We use cells that weigh 20 to 50 pounds each,
23 but still we need about 100 to 200 of these cells in
24 every one of our vehicles.

25 It's a lot better than if we used the kinds of

1 cells that are used in, say, a Tesla, where we would
2 need thousands of them.

3 But even with just -- just a hundred cells or
4 200 cells on a vehicle, those cells will -- because of
5 inevitable differences in manufacturing tolerances,
6 those cells will get out of balance as the vehicle is
7 used. And you need a system, a Smart system on the
8 vehicle that can balance those cells and keep them in
9 balance if the vehicle is to maintain its optimum
10 operating range and if the batteries are to last as long
11 as you need them to.

12 So, cell balancing is very important.

13 Different ways of packaging batteries and
14 possibly even developing a technology which was tried by
15 a company called Better Place, a few years ago, for
16 automobiles. But it may have more of a better chance of
17 making it in the heavy-duty market. Some kind of
18 battery swap technology would probably be beneficial.

19 That would probably require some redesign of the
20 trucks themselves, or the buses themselves. But it
21 is -- again, it's a technology that is probably worth
22 looking into at some point.

23 Moving over to the right, power conversion and,
24 again, our inverter charger is shown there. It's a
25 fairly unique and complex product. One of the key

1 needs, now, is to get its cost down. In round numbers,
2 that device costs about \$20,000 to \$25,000 to build.

3 And so, it obviously is not, at that price
4 level, something you could afford to put in every
5 automobile.

6 But if you get its cost down by a factor of ten,
7 and I know Nissan has sold 100,000 Leafs. So could you,
8 at a production rate of 100,000 of these get the cost
9 down from \$20,000 to \$2,000? That's a question I think
10 is worth asking. It could have a transformative effect
11 on the industry if you could put a charger in every car.

12 Also, one thing we're finding is that after we
13 get funded to develop these products, to sell them
14 commercially sometimes there are additional hurdles we
15 have to overcome, like getting UL certification, and
16 having a nationally recognized lab test the product.
17 That can be very expensive, so some sort of funding
18 availability to help companies, after they develop
19 products, get them certified and get them to market
20 could be helpful.

21 The motive drive system, as proud as I am of the
22 fact that we found the second life for the Fisker motor,
23 one of the issues with that motor is that after it was
24 designed by Quantum here, in California, it was
25 outsourced to a factory in China, and it's built by a

1 company called JJE in China.

2 So, it would be one of the things that I think
3 would be beneficial is if we could find a way to build
4 motors that sophisticated and that inexpensively here in
5 California.

6 So, some motor technologies, or switched
7 reluctance and brushless DC motors are two technologies
8 that could -- that we might benefit from further
9 research into those areas.

10 And methods tooling and methods for low-cost
11 motor manufacturing could have some long-term payoffs,
12 as well.

13 MR. MC KINNEY: So, Mike, just a friendly time
14 check, if you could move to completion please?

15 MR. SIMON: Okay, sorry I'm going too long.

16 Vehicle control, anticipatory controls is
17 basically knowing from your Google map where a vehicle
18 with a (inaudible) is going and be able to gauge how
19 much battery power or energy to use from what source
20 based on what the vehicle's going to do, instead of what
21 it's necessarily doing right now, and various other
22 controls technologies.

23 Just stepping back, just some of the other
24 recommendations on how to address the cost challenges,
25 specifically, not just the technologies, but getting the

1 cost of these vehicles down. Larger scale
2 demonstrations than what have typically been funded in
3 the heavy-duty sector would be helpful because you
4 always get more economies of scale if you can order 10,
5 or 20, or 50 of something instead of just one, or two,
6 or five.

7 The manufacturing initiatives, especially the
8 manufacturing of initiatives that help fund the tooling
9 to reduce the costs of manufacturing that can have a big
10 impact on reducing costs.

11 And then for smaller-scale demonstrations we
12 believe that there still is a roll for those because,
13 again, you always have more vehicle models to convert,
14 and more of these specific technologies and you don't
15 want to make a mistake.

16 While we need some larger-scale demonstration to
17 get costs down, you want to be careful that for larger-
18 scale demonstrations you use components that have
19 already been proven in smaller-scale demonstrations.
20 Otherwise, you know, you'll have to fix bugs on 50
21 vehicles, instead of five, which is a lot more
22 expensive.

23 This is my last chart. I just tried -- these
24 are wild guesses, but I've just tried to put some meat
25 on the recommendations here by kind of showing you what

1 the colored cost for each -- for a big, heavy-duty
2 truck, a big, heavy-duty electric truck of the type
3 we're building, what the cost is for each of the major
4 components that we install, and what we think is a
5 reasonable long-range target cost.

6 Long-range, I just mean five or ten years. I
7 don't mean 50 years and I don't mean a million units. I
8 mean, you know, just getting to maybe a few hundred
9 vehicles per year by 2020 or 2025 and we think we can
10 get down to the target cost numbers there.

11 You can read for yourself what those numbers
12 are, but the bottom line is that, you know, we think
13 there's a potential to reduce the cost of these vehicles
14 by about \$200,000, which would roughly cut the cost of
15 building a truck like this in half, and I think put it
16 in reach of many fleet operators, especially if you
17 continued having a hybrid vehicle incentive program type
18 mechanism where they could maybe buy a truck for
19 \$200,000, but get \$100,000 subsidized. And then they
20 have a price for the same price as a diesel truck.

21 That would be the dream scenario and that would
22 guarantee putting, you know, thousands of these trucks
23 on the road, in our view.

24 So, again, sorry I went overtime but that
25 concludes my presentation.

1 MR. MC KINNEY: No, thank you very much, Mike,
2 it's very informative.

3 Commissioner, do you have any follow-up
4 questions?

5 COMMISSIONER SCOTT: I do not, but a very
6 informative presentation, thank you.

7 MR. MC KINNEY: Yeah, thank you very much, Mike.

8 Our final speaker for this panel is Dr. Jeffrey
9 Reed, who is Director of Business Strategy and
10 Development for Southern California Gas Company.

11 And in that capacity he leads development of
12 policies and initiatives for supporting the development
13 and deployment of sustainable energy solutions.

14 He currently leads the Natural Gas RD&D Energy
15 Efficiency Technology sections, and then Venture
16 Investment and Low Emission Vehicle programs.

17 He has a Doctor in Engineering from Cal and a
18 Master's in Business from Stanford University, so Dr.
19 Reed.

20 MR. REED: Thank you very much. It's a pleasure
21 to be here. Thank you for inviting me here, Jim. And
22 thank you, Commissioner, as well, for having me here.

23 So my role on this panel is to talk about
24 natural gas-related pathways in which we include
25 renewable natural gas and renewable gaseous fuels in the

1 out years.

2 And this perspective is the perspective of SoCal
3 Gas. But I would like to say that we have received
4 input and collaboration on this from many quarters,
5 including a lot of manufacturers, research entities, a
6 number of consultants which I won't name because I'll
7 forget one and offend them.

8 And as well, the project work that we do at
9 SoCal Gas, much of which is collaboratively funded
10 between ourselves and the CEC, South Coast, and San
11 Joaquin.

12 So with that, and also I'd like to comment that
13 the focus here is intentionally the 10-year horizon, but
14 for us that's also a lot about what is the starting
15 point on the pathway toward 2050.

16 Because much of this work that we've done over
17 the last several years has been in relation to
18 conversations with policy makers going back a number of
19 years about natural gas has been a low-emission vehicle
20 fuel to date. It's been one of the foundations of
21 starting into that path.

22 But what's the long-term perspective? How is
23 natural gas consistent with 2050? And what should we be
24 investing in now, in relation to our longer-term goals?

25 As a foundational item, natural gas is currently

1 inexpensive and looks to stay that way for quite a long
2 time to come. It's a domestic fuel and it's very clean
3 to s tart with.

4 So, that sort of drives the question of, you
5 know, how can we take advantage of this cost position of
6 natural gas but build on its current technology position
7 in order to advance further toward our longer-term
8 goals, both for criteria pollutants, as well as
9 greenhouse gas.

10 So, as an overview and I think I've said some of
11 this already, but natural gas technology is relatively
12 mature. So, one important point to make at the start of
13 this discussion is that if we look at the four or five
14 different technology pathway areas that we've talked
15 about today, all of them have significant potential and
16 all of them have some degree of uncertainty as to where
17 they will wind up in the next 10, 20 or 30 years.

18 When looking at natural gas technology strategy
19 and policy I think it should be viewed as well from a
20 technology risk, time and cost perspective.

21 So, when we look at the portfolio approach, kind
22 of all the above strategies, one of the important roles
23 of these technologies is that there's a pretty high
24 degree of certainty that they can move a long way toward
25 these goals without break through levels of technology

1 development, but with more incremental levels of
2 development.

3 So, one key point is timing. Our view is that
4 accelerated deployment in the coming years, particularly
5 the coming decade of next generation natural gas
6 technologies is critical to the air emissions goals of,
7 in particular, South Coast and San Joaquin.

8 So, I think Matt showed a version of this chart
9 earlier and this sort of looks at trajectories of
10 emissions in the different areas.

11 And the basic point of it is that in the mid
12 years, in the 2020 to 2030 time frame we're falling
13 behind the goals.

14 And so, one consideration is that more rapid
15 deployment of, you know, relatively near-term natural
16 gas technologies can help put those glide paths on a
17 steeper trajectory in the near years.

18 In addition to the heavy-duty applications that
19 we're here to discuss today, primarily there are -- as
20 you've heard from some of the other technology
21 categories, there are other applications that can be
22 served by natural gas to achieve similar emissions
23 benefits.

24 And in particular, all the high horsepower
25 heavy-duty applications, including rail, port operations

1 and those applications can be served as natural gas, as
2 well.

3 One of the questions posed for the workshop by
4 Jim was, you know, what do we see as the potential
5 deployment.

6 Many of you may be aware of some deployment
7 forecasts that were done in the 2009 time frame by ICF
8 Consulting, for the Energy Commission that showed NGV
9 adoption ranges of sort of the high and medium low
10 perspective, with the mid-case showing adoption at about
11 15 percent per year growth rate.

12 We've been a little bit behind that trajectory,
13 but we've refreshed that in collaboration with a number
14 of parties, including CalHEAT, (inaudible), Andrus and
15 others.

16 And our expectation really based more on
17 economic adoption than on any other thing, as we could
18 see 25 percent or so of the heavy-duty vehicle fleet
19 fueled by natural gas in the 2030 time frame.

20 And that's basically done by looking at specific
21 duty cycles and vocations. As Matt had mentioned, ones
22 where there's an economic proposition for adopting
23 natural gas.

24 So, one of the things that I think we need to
25 drive in the State is to say, you know, this economics

1 is not just a property of California, it's a property of
2 the U.S.

3 So, one of the things that California can do
4 perhaps to address some of the go-it-alone cost burden
5 that we have is to drive development of natural gas
6 technologies that are low emission technologies, that
7 would then be adopted in states that don't have the
8 regulatory drivers that we have in California.

9 So, effectively, if we look at the two main
10 goals from an environmental perspective, criteria
11 pollutants which is primarily NOx, as a precursor to
12 ozone, and then greenhouse gas, there's -- you know,
13 just as an organizing framework, we look at five levers
14 that we can use to achieve those goals and some of them
15 are common.

16 All the ones that address efficiency have a full
17 benefit, both on NOx and GHG. So, engine design, drive
18 trains including hybridization, aerodynamics, light-
19 weight materials, rolling resistance, all those types of
20 things are efficiency, total system efficiency
21 improvements that benefit both NOx and GHG.

22 And then specifically to the NOx side, we can
23 work on after-treatment systems, either three-way
24 catalysts or selected catalytic reduction as the primary
25 methods.

1 And then for GHG, in the 2030 and beyond time
2 frame, we'll need to have significant quantities of
3 renewable gaseous fuel to mix in order to meet the
4 greenhouse gas goals over the long term that would start
5 with waste-derived biogas resources. Eventually, later
6 we can have other pathways that we'll talk about briefly
7 at the end.

8 So, if you look sort of pictorially on how these
9 reduction potentials look like in different time frames,
10 the perspective we have and also what Matt has mentioned
11 in his presentation about the program we've funded,
12 following our solicitation.

13 We believe, actually, that the ability to
14 achieve 75 to 80 percent lower NOx than currently
15 mandated levels is available with current technology,
16 but simply needs, effectively, policy and regulatory
17 forcing functions to get that to happen.

18 So, we're moving forward with demonstrating that
19 and expect to have that hardware demonstrated within the
20 next three years.

21 And then we believe with further development in
22 the future cycles we can move even further with advances
23 on that same technology, but also benefitting from the
24 increased efficiency throughout the vehicle system that
25 we talk about on the prior side.

1 On the GHG side there's a greenhouse gas benefit
2 simply from moving from petroleum-based fuels to natural
3 gas, so that's the starting point.

4 Then the next step comes from those efficiency
5 improvements that we talked about. Between those two
6 effects, we can get almost 50 percent lower GHG
7 emissions than we have today, and then the remainder
8 comes through renewable gaseous fuel blends in future
9 time frames.

10 So, I'm not sure when I started. How far in am
11 I, Jim, time wise?

12 Okay, so we'll go into a little bit more detail
13 in both what happens in these different notional time
14 frames that we've laid out and then we'll talk about a
15 few integrated vehicle systems and how you might look at
16 sort of many roadmaps for different vocations.

17 So, relative to NOx, the starting point here is
18 the 0.2 grams per brake horsepower mile standard.

19 As I mentioned on the prior slide, we believe
20 that in the near term we can get down to about 0.05 and
21 shortly thereafter to a full 90 percent reduction from
22 where we are today.

23 And as I mentioned on the prior slide, the two
24 primary mechanisms there are increasing efficiency of
25 the total vehicle system and then continuing advances in

1 the after-treatment systems.

2 In the next ten years that will be primarily
3 work on three-way catalysts with rich burn engines. In
4 the outer years it would be possible to also look at
5 selected catalytic reduction for lean burn engines,
6 which would be more commensurate with the approaches
7 currently used for diesel, but would also potentially
8 provide collateral efficiency benefits.

9 And in the outer part of the time frame we're
10 reflecting additional, effectively hybridization using
11 catenary plug-in, et cetera. When exactly that happens
12 time frame-wise, depends a lot on what the cost
13 progression of those technologies is.

14 So, on the greenhouse side of things, all the
15 efficiency-related measures are the same, providing the
16 great GHG benefits, in addition to the NOx benefits.

17 But in this scenario it requires development and
18 deployment, as I said, of the renewable natural gas and
19 hydrogen blends to address the greenhouse gas.

20 So, one point in terms of just driving
21 deployment, and we'll get into some of the various
22 applications, but cost is a big factor, and reducing
23 deployment cost is key.

24 So, we also are looking increasingly at sort of
25 more integrative looks at infrastructure around ports

1 and things like that.

2 John mentioned the corridor areas. So, the
3 total ecosystem around the ports, if we look at that in
4 terms of how we can best reduce emissions, you open
5 further avenues for both CNG and liquefied natural gas,
6 and to be able to take advantage of scale economies in
7 the equipment that's deployed.

8 So, the next few slides are sort of mini-
9 roadmaps or vignettes for particular applications and
10 how we might see the technologies play out.

11 These are point scenarios, so this isn't
12 necessarily exactly how this would look.

13 But in the heavy-duty sector we start out today
14 from a pretty low emissions profile, and relatively
15 well-advanced technologies for spark ignition, with
16 three-way catalysts and exhaust gas recirculation.

17 There's room for significant improvement in
18 those areas of relatively modest incremental cost that
19 we're working with South Coast and others to
20 demonstrate that could take us about 75 percent or so
21 below that level.

22 And in addition, over the near term we think 10
23 or so percent improvement in efficiency is possible.

24 And then, so that gets us 75 percent or so NOx
25 reductions, 30 or so percent GHG reductions in the 2023

1 time frame. Then from 2023 out to 2032, and eventually
2 to the 2050 time frame all those further advances in
3 lightweight materials, rolling resistance and those
4 things.

5 And then also, potentially, the advance of
6 turbine drive, so it's not limited to internal
7 combustion engines. We can also potentially envision
8 turbine drive. And both of those could be in various
9 types of hybrid configurations.

10 So, for the drayage and short hauls, the
11 different duty cycle, so we envision in that case
12 similar improvement avenues in the near term. But
13 given, you know, the issues around the port, the
14 different duty cycle, we see earlier deployment of
15 hybrid and zero emission mile elements there, as Matt
16 also discussed in his discussion.

17 So, cargo handling equipment, I think similar to
18 the drayage and with similar solutions; zero emission
19 miles, hybridization in the future years, potentially
20 fuel cell as well.

21 So, another application area that has a lot of
22 potential benefit and this, as well as the oceangoing --
23 or the seagoing applications have the feature that
24 they're both starting from a relatively high emissions
25 profile starting point. They're much higher emissions

1 than is the case with current vehicle applications.

2 Therefore, the percentage reductions that can be
3 achieved by deploying technology in the near term are
4 higher than they are for the others.

5 Fundamentally, the rail and vessel applications
6 are similar in technology avenues as what we talked
7 about before. However, things like aerodynamics and
8 rolling resistance obviously not as important.

9 But on these larger-duty pieces of equipment
10 there's more room on board for storage of LNG and so, a
11 significant opportunity for those.

12 And here's the ships and, again, the current
13 emissions profiles are high and the fuels are not
14 particularly clean, so there's a lot of room for near-
15 term improvement.

16 So, the last thing I'd like to talk about is a
17 little bit on the renewable natural gas and related
18 hydrogen pathways. It's critical to the pathways that
19 I've been discussing, when you get beyond 2030 or 2035
20 that these renewable gaseous fuels become available in
21 order to move beyond the 50 percent or so reduction in
22 GHG down to the 80 percent levels that we need.

23 So, I think many of you are aware, but perhaps
24 not everyone, that there are quite a large number of
25 pathways being worked on in this area.

1 These ones are ones that lead to methane to be
2 injected into the natural gas system. There are other,
3 quite a few other pathways that have other
4 configurations.

5 And there are somewhere -- on this diagram all
6 the pathways shown are leading to methane.

7 There's another one where you could take the
8 renewable hydrogen production and blend it with the
9 natural gas pipeline. That's something that we're
10 beginning to look at increasingly, as well.

11 What percentages would ultimately be considered
12 safe and, you know, acceptable under impact on equipment
13 is something that we're beginning to study.

14 But, you know, this is where we were I think
15 with looking at biogas compositions about five years ago
16 so, you know, this is sort of at the early stages.

17 But over the coming several years we'll be
18 establishing what we think those limits should be.

19 I think one important thing to note is that with
20 the organic waste-based pathways they're already
21 relatively cheap, if you think about it in terms of a
22 renewable vehicle fuel.

23 So, at \$10 per million Btu, when you compare
24 that to geological gas at \$3 or \$4, you may say it's not
25 particularly cost competitive, but that's not really the

1 substitute resource. The substitute resource would be
2 renewable fuel.

3 So, at \$10 per million Btu uncompressed you're
4 below a dollar a gallon, which is pretty attractive,
5 even at the \$40 range.

6 So, on this chart the cost kind of goes up as
7 you go up the chart on the left. So, the organic waste
8 is the least expensive, that can probably be in the \$10
9 to \$15 range.

10 Then if you have a purpose-built digester
11 gasification system, you're probably getting up to
12 around \$20.

13 The electrolysis and solar thermal catalytic or
14 artificial photosynthesis are currently at \$40. That's
15 in the \$5 to \$6 a gallon range. So, you know, it's
16 expensive relative to conventional gas, but it's not
17 orders of magnitude out of the cost competitive range.

18 And also, on the upper part although more
19 expensive today it has more room for breakthrough levels
20 of improvement in those technologies.

21 And the solar pathway is what the Berkeley and
22 Cal Tech Joint Energy Research Hub is working on the
23 artificial photosynthesis work.

24 So, anyway, we think all of these avenues of
25 advancement we've talked about have a lot of potential.

1 They're exciting. And, you know, we would go back to
2 kind of the starting point of the discussion which is
3 that the foundation point of these is already pretty
4 clean and pretty efficient. There's a lot of room for
5 advancement.

6 And on most of the pathways, if you look at it
7 from a technology readiness level, or a risk point of
8 view, likelihood of achievement, they're relatively
9 high. So, it makes a lot of sense from a portfolio
10 management point of view to put a significant amount of
11 effort into these pathways.

12 Lastly, you can see on a number of these charts
13 there is synergy with other the pathways being worked
14 on. Many of the things that I've talked about would be
15 applicable to, say, liquid biofuels. Not the -- you
16 know, not the complete cycle but, you know, many of the
17 things.

18 And then a lot of it also has technology
19 synergies with the fuel cell vehicle pathways. So,
20 compression and storage, which were mentioned in some of
21 those presentations and some of the other aspects would
22 have dual benefit to both pathways.

23 Thank you.

24 MR. MC KINNEY: Thank you very much, Dr. Reed,
25 that was very, very informative.

1 Commissioner, do you have any comments or
2 questions?

3 COMMISSIONER SCOTT: Also another excellent and
4 informative presentation.

5 I had a question for you on, I think it's slide
6 six, and it was where you were showing how the
7 population of -- how we might have an increased
8 population of natural gas vehicles.

9 And I wondered why the transit sort of stays
10 stagnant across the years and why it takes a little time
11 after 2020 before we would see -- or we would
12 potentially see the drayage trucks and the ports bump
13 up?

14 MR. REED: Well, I -- well, we would have to get
15 back to you with some of the specifics. But the answer
16 would generally be that these sectors have different
17 levels of penetration currently. And if there's 30 or
18 so percent of transit that's not currently using CNG,
19 there may be particular reasons in the analysis for why
20 it's not suitable.

21 Or perhaps the assumption that, you know, the
22 other 30 percent of transit agencies will be making a
23 different decision on, you know, fuel cell drive or
24 something else over the time period.

25 So, it's a combination. In each of these

1 vocations of current trend, the economic benefit of
2 adopting natural gas, and then some judgment of, you
3 know, what the adoption will be.

4 COMMISSIONER SCOTT: Great, thank you.

5 MR. MC KINNEY: And I think my takeaway from
6 this, you know, the State is embarking on several kind
7 of major efforts to assess optimal strategies for
8 freight movement -- goods movement, freight transport,
9 and really how to meet these pending NOx goals.

10 And I think the thing that's really interesting
11 with your presentation, Dr. Reed, is that you're really
12 not talking about natural gas just as an interim
13 bridging fuel, which has been a traditional way we've
14 thought about it, but is something that can reach all
15 the environmental and carbon performance standards that
16 the regulatory agencies will have to set over the coming
17 years.

18 And I think that's just very interesting and
19 timely in terms of these policy discussions that we'll
20 be having amongst different branches of California
21 government this year and next year. So, thank you very
22 much.

23 MR. REED: Thank you.

24 MR. MC KINNEY: So, with that I want to thank
25 the panel. Again, just stellar presentations by all of

1 you, you're all really, really knowledgeable, so thank
2 you so much.

3 (Applause)

4 MS. RAITT: We'll take a quick break to re-set
5 up for the next panel, thanks.

6 (Off the record)

7 MR. MC KINNEY: Panel four is Biofuels
8 Technology Assessment, ARFVTP Strategic Goals for
9 Biofuels, biodiesel, and biogas, or renewable gas.
10 And again, all of these apply directly to our
11 statewide policy goals of reducing diesel fuel use,
12 improving air quality, enhancing public health and
13 reducing carbon emissions.

14 And I think as I said in my introductory
15 remarks, we've got about \$90 million invested to date in
16 various sectors of the biofuels industry in California.
17 A little less than half of that is in the biogas sector,
18 followed by biodiesel, and then ethanol, and a little
19 bit in green gasoline.

20 So, I'm very pleased with our final panel for
21 today. We have about 15 minutes allocated for each of
22 you. And we've got just a really nice array of both
23 private sector here, and academia, and then the public
24 sector or NGOs.

25 Our first speaker is going to be Nathan Parker,

1 who is a post-doc scholar at the Institute for
2 Transportation Studies at UC Davis. And I've worked
3 with Nathan for many years, now, and I'm just very
4 pleased to see the development of his academic career.

5 His research seeks to understand the potential
6 for biomass energy in California and the United States
7 through systems level modeling.

8 He has written 15 journal articles and book
9 chapters on the subject of alternative fuels. And he
10 received his MS and PhD degrees in Transportation
11 Technology and Policy from UC Davis. So welcome,
12 Nathan.

13 MR. PARKER: Thank you, Jim.

14 Okay, so I'm here giving a presentation. Some
15 of this work is also from my collaborators at UC Davis,
16 Lew Fulton, Julie Whitcover and Geoff Morrison.

17 So, I'm going to be a little bit academic
18 because I'm the academic around here. So, I'm going to
19 give a quick overview of the State of California
20 biofuels and the potential.

21 An estimate of kind of advanced biofuels, what
22 we think they cost, and what we think California's
23 potential is to produce those kinds of fuels.

24 A little tidbit on how the advanced or
25 cellulosic biofuels are developing.

1 And then we're going to go through some comments
2 on how they might develop in the future. Is there a
3 path for that that is better than what we initially
4 considered in biofuel policies?

5 And then another little tidbit on policy
6 incentives, what's happening in the market? Where are
7 the price signals coming from in terms of policies?

8 So, in terms of the biofuels in California,
9 California has been a major player in the knowledge base
10 for biofuels. We haven't been a major player in terms
11 of biofuel production relative to the rest of the U.S.
12 and Brazil, for example.

13 But there's a lot of firms who are based in
14 California. And there's a lot of -- there is some
15 movement in terms of production capacity.

16 And then I have little question marks on all of
17 my things. Those aren't question marks, those are
18 actually the information.

19 If we look at what's the resource base in
20 California, this is without energy crops. I think
21 California has roughly .5 exajoules, which is about 1.5
22 to 2 billion gallons of gas in equivalent. It's energy
23 value of biomass and resources as found by the
24 (inaudible) Biomass Collaborative, a resource assessment
25 that's been in draft form.

1 And of this resource, though, a significant
2 fraction of it is woody leaf, woody resources from the
3 forest sector.

4 But there's also a lot of anaerobic digester
5 feedstock, the AD feedstock wedge there includes food
6 waste, manures, and wastewater treatment biogas.

7 And then the blue wedge there is landfill gas.

8 And another interesting part of this is the
9 small sliver of waste oils which shows that there isn't
10 a large potential for waste-based biodiesel or renewable
11 diesel, or renewable jet fuel coming out of California.

12 There is some potential and it should be
13 exploited as much as we can.

14 Wow, lots of question marks, interesting.

15 MR. MC KINNEY: Yeah, sorry about that, Nate, I
16 don't know what happened in the translation.

17 MR. PARKER: You didn't believe my slide.

18 (Laughter)

19 MR. MC KINNEY: It wasn't me.

20 MR. PARKER: So, I put together this, which is
21 an assessment of the cost of production of different
22 types of biofuels.

23 Anaerobic digestion producing renewable natural
24 gas, renewable jet and renewable diesel fuels through
25 oil-based processes, using fast pyrolysis, which is a

1 cellulosic resource. Fischer Tropes diesel, cellulosic
2 ethanol and then RNG via gasification, producing
3 renewable natural gas through a gasification process,
4 and that was touched on in the last session a little
5 bit.

6 You can see this is academic literature
7 estimates on what the costs look like in kind of nearish
8 term for these facilities.

9 And then on the far right we have what that
10 California potential mapped to these technologies, so
11 you can get an idea of the scale of the resource in
12 California that can be tapped by each of the
13 technologies.

14 And the highlight of this is that we really
15 would like to get into some of these cellulosic resource
16 bases, if cellulosic technology -- if we're going to
17 make a big dent or have a large-scale production in
18 California.

19 So these cellulosic technologies, they're a
20 little bit problematic because a lot of them are -- or
21 the way we've conceptualized them and have been
22 attempted in the past have been large-scale facilities
23 that if you scale them up, they look like they have a
24 decent change of being competitive. But scaling them up
25 requires really large capital investments.

1 And what I wanted to show here is the comparison
2 of the academic literature, what we think the capital
3 investment is for these different plants.

4 So, on the left we have cellulosic ethanol and
5 on the right we have pyrolysis-based diesel and how the
6 plants that are being built in the last couple years
7 compare with these estimates.

8 And what we see here is that they compare --
9 they are being built at a smaller scale, but they are
10 kind of in line with the economies of scale that are
11 expected to be at play.

12 So, these fuels may be more expensive now, but
13 if they scale up as expected, they are not -- they play
14 the role that we were expecting originally.

15 So this, I want to pose kind of a framework of
16 thinking about biofuels and that is that we have -- when
17 we have evaluated policies, like the Low Carbon Fuel
18 Standard in California, or the Renewable Fuel Standard
19 for the U.S., we thought about these large-scale
20 facilities that require large capital investment, and
21 facilities that we don't know how well they would work.
22 And there's been a lot of policy push behind that.

23 In the meantime there's some -- in traditional
24 biofuels there's been incremental improvements going on
25 in those core ethanol and biodiesel facilities that are

1 yielding significant carbon intensity reductions overall
2 if you aggregate across a large number of facilities,
3 but are small increments and have low financial risk.

4 And then there's some interesting plays with
5 that, that have high carbon intensity reduction and
6 relatively low financial risk, but they tend to be
7 characterized by having low future potential. So, the
8 little blue dots up there are these -- it's what I would
9 consider for the waste-based renewable diesels or
10 biodiesels.

11 They're really interesting, but they don't have
12 a really large, long-time large potential to make a big
13 impact.

14 So, and in between there's a -- what we're
15 looking for is a path to go from where we are now to
16 these technologies that are tapping into the large-scale
17 cellulosic resource.

18 And we're seeing some of this come about and I'm
19 guessing that Tom will be talking a little bit about
20 this later on.

21 But for ethanol there's technologies being
22 produced -- being looked at for corn fiber, taking part
23 of the cellulosic component of the corn grain, and
24 that's kind of a very small incremental way into
25 cellulosic fuels.

1 And then you get experience with enzymes. And
2 then that can play out and go farther into bagasse and
3 Stover, kind of ethanol plants that have bigger capital
4 costs, capital expenses but would be less risky if
5 you've gotten through the enzyme learning before you try
6 to do that in one step.

7 And so, we're looking at if we can elucidate
8 pathways. And right now the most obvious pathway we can
9 see, right, is through the ethanol pathway from
10 traditional ethanol to cellulosic.

11 But we're looking to see if we can find some
12 more incremental pathways for -- or transitional
13 pathways for the pyrolysis or leading into diesel-like
14 fuels.

15 And the final comment I'd like to make is we
16 haven't seen a lot of these large-scale cellulosic fuels
17 come into the market. And one of the questions is why?

18 And there's been a lot of reasons why they
19 haven't proceeded as fast as expected, given I've
20 been -- I've been having my head in Federal policy and
21 so the RFS is not getting there. But partially that's
22 because the policy was just extremely optimistic to
23 begin with.

24 The other aspects are what is -- we're only
25 recent giving a value to this fuel, a special value to

1 this fuel. And we're doing it through RIN and LCFS
2 credit prices, and those have been very volatile and
3 very uncertain of whether they're going to be durable.

4 And so, this slide highlights how that -- how
5 these credits play out for the different technologies.

6 So, for corn ethanol, when you have a low RIN
7 price and some LCFS price you don't really have much of
8 an incentive.

9 But when you get to the larger RIN prices we're
10 driving higher prices for corn ethanol, but LCFS values
11 are not driving too much value in corn ethanol.

12 In comparison, waste-based biodiesel, for
13 instance, the LCFS value has a much higher value to
14 them, but it bounces up and down a little bit.

15 And this is -- as a market signal it's not the
16 greatest thing. It is good to have a market signal.
17 The question is how durable will it be and will it be a
18 bankable signal for the fuel providers to put these in
19 place.

20 And current history is that it's very volatile.
21 It looks like it has some significant value, but whether
22 it's a durable signal is questionable, and it's
23 reasonable to not bank on it for your investment.

24 But as the policy proceeds and if this remains
25 in place as a durable signal, this will provide a really

1 large incentive to move in the direction of these fuels.

2 So in conclusion I wanted to say that some of
3 the waste oil supplies are limited but are pretty
4 important in terms of getting us some good near-term
5 reductions, showing good progress on this.

6 We kind of need to get to a cellulosic or algae-
7 based resource base if we want to have large-scale
8 biofuel production.

9 And then the path there with a good business
10 case at every step is unclear to me. It may be clearer
11 to others in the room, but it's unclear to me.

12 And that's what I have.

13 MR. MC KINNEY: Great, thank you very much,
14 Nathan.

15 Did you have any follow-up questions,
16 Commissioner Scott?

17 COMMISSIONER SCOTT: But I did have a question
18 but I think your last bullet point might have answered
19 it. And I was going to ask you about one of the themes
20 that we've kind of hearing throughout the day is a
21 potential for trying to accelerate some of these
22 pathways.

23 And so I was going to ask if you had some
24 thoughts on, kind of back on your slide six of places
25 where we might be able to accelerate that. But then I

1 also note that you ended with the path there, with a
2 good business case is unclear so --

3 MR. PARKER: Well, so for -- we see a pretty
4 decent business case or incremental multiple steps
5 taking smaller steps case for the ethanol path and to
6 get you into cellulosics through kind of fiber, bagasse
7 or -- so, we haven't fully explored this in terms of
8 pyrolysis or Fischer Tropes type thermochemical
9 processes to get to jet or diesel fuels, which I think
10 are actually the more interesting ones to get into the
11 market.

12 COMMISSIONER SCOTT: Thank you for that
13 thoughtful presentation.

14 MR. MC KINNEY: Yeah, and I also had a follow-up
15 question I think on a similar point to the
16 Commissioner's.

17 So, it sounds like you're somewhat pessimistic,
18 so the blue diamonds there are biodiesel or renewable
19 diesel kind of opportunities in California.

20 And is that due primarily to the feedstock
21 constraint going in or are there some other factors?
22 Because I think we're thinking about it a little
23 differently at the Commission staff level, at least,
24 that it's quite exciting what's happening with waste-
25 based biodiesel right now.

1 MR. PARKER: Yeah, from my perspective, it's the
2 resource base that -- the waste-based resources is
3 limited. You soon get to where you have to produce oils
4 for the purpose of producing biodiesel or renewable
5 diesel, and that gets you into a much thornier problem.

6 And there might be solutions to that, but there
7 are -- there's relatively few options that don't require
8 significant land that -- and the food oil market is very
9 fungible and you end up with tracings back -- you can
10 get your way to cutting down forests pretty fast if you
11 start using oil seeds that could be used for food.

12 MR. MC KINNEY: Okay, well, thank you very much,
13 Dr. Parker.

14 So, our next speaker, actually our next two
15 panelists are from the private sector and both of them
16 are grantees with the ARFVTP.

17 And Harry Simpson is the CEO of Crimson
18 Renewables and he is one of our more recent grantees,
19 and we're going to help finance a major expansion of his
20 biodiesel facility down in Kern County.

21 And Harry, I didn't get a biography from you, so
22 if you want to say a few more words of introduction
23 about yourself feel free to do so, or you can just go to
24 your presentation.

25 Oh, my bad. Okay, excuse me.

1 MR. SIMPSON: Well, my background has really
2 been in the technology market for (off-mic) -- doing
3 venture capital, technology companies where I've been
4 President, COO, CFO, Head of Marketing.

5 And it's been an interesting ride for six years
6 in the renewable fuel space.

7 I'll get started now that it's ready. So, our
8 company is a biodiesel producer. We're the largest
9 producer here in California. We currently produce about
10 10 million gallons and we run most of that on used
11 cooking oil, as well as some inedible corn oil that is
12 coming out of ethanol plants, and also some animal fats.

13 We sell, generally, to major oil companies, but
14 also to fuel wholesalers and truck stop operators.

15 Jim mentioned we received a grant, which we are
16 currently spending that money to expand the plant. The
17 work's already begun and we'll complete that, if we're
18 lucky, at the very end of this year, but that has
19 something to do with what happens with tax policy at the
20 Federal level, and what we do with our production
21 operations as a result. But worst case, it will be
22 early next year.

23 And glycerin is produced as a byproduct. And I
24 told you a little bit about where we take that, so
25 enough about us.

1 Biodiesel is something that nationally has sort
2 of stepped onto the fuels markets landscape in a much
3 more significant way, in particular in the last five
4 years, you know, getting to about 1.8 billion gallons
5 last year.

6 It's also grown significantly in California, but
7 really only in the last two years.

8 Last year biodiesel consumption was about 50
9 million gallons, 45 to 50, somewhere in that range.
10 Renewable diesel was probably in the 20 to 25 range.

11 And these are some numbers for what's going to
12 happen this year which, you know, there's somewhat of a
13 range really due to what happens with the value of RINs
14 from the RFS program and LCFS credits.

15 Nathan's slide showed some of that volatility.
16 LCFS credits have actually plummeted from what he
17 showed. I think today they traded at 18 bucks a ton.
18 And the low trade was maybe two days ago at 16.

19 And that's really a function of what's
20 happening. You know, all the price drops came on the
21 back of the CARB workshop on changes to LCFS.

22 So, as every time policymakers tinker with
23 established policy it creates gyrations in the
24 marketplace and that's what we're seeing now.

25 What's driving it here in California, I mean

1 LCFS is the big driver, but that in turn is really
2 driving the investments that were made in fuel
3 infrastructure in the last two years, particularly at
4 the bulk fuel terminals in terms of refinery racks and
5 pipeline service terminals that enable the blending of
6 biodiesel and renewable diesel.

7 So, it's storage and blending equipment. This
8 gives you some idea here of, you know, going from one
9 terminal to about eight terminals last year.

10 Chevron, Tesoro and Kinder Morgan are all going
11 to be adding additional terminals with blending
12 capabilities and storage capabilities for alternative
13 diesels this year.

14 I will say it will probably go into next year
15 with the capacity to blend, from a biodiesel
16 perspective. In 2015 I would expect somewhere between
17 140 to 160 million gallons of biodiesel.

18 And renewable diesel probably a similar number,
19 that's a little less constrained from a blending
20 perspective, more constrained from a storage
21 perspective, and the fact that renewable diesel is
22 typically not made in California. It's typically not
23 even made in the United States and it's imported in
24 ocean-going cargos from Asia.

25 You know, there was some talk about -- one of

1 the points today is how can we get to sort of a zero,
2 you know, ZEV future?

3 In the world of diesel, in looking at heavy-duty
4 diesel, with the new diesel engines we're almost there
5 now, particularly new diesel engines that are burning
6 alternative fuels.

7 Biodiesel brings significant reductions in PM,
8 depending on the research. Particularly with -- but
9 with new diesel engines with the catalytic -- you know,
10 the SCRs that are built into those machines, catalytic
11 reduction technologies that are available in new diesel
12 engines, you get to -- very close to a ZEV world, you
13 know, now. And that's what this slide is showing.

14 In California, Nathan, I'm not sure where you
15 got some of your numbers but, realistically, we have
16 about 45 million gallons of production capacity in
17 California. My company represents about a fourth of
18 that.

19 Most of the biodiesel produced in California is
20 from used cooking oil or other second use feedstocks,
21 like inedible corn oil, or animal fats.

22 There's one renewable diesel producer in
23 California, (inaudible) Refining, and they run typically
24 animal fats.

25 LCFS is really driving -- you know, if we looked

1 at the figures for this year for what we're expecting in
2 the marketplace, 75 to 90 million gallons of biodiesel,
3 most of that's going to come from out of state, or half
4 of it, maybe a little less if we're at the low end of
5 that number.

6 And that's being driven by LCFS. So, the types
7 of biodiesel that are coming in here are very low CI
8 biodiesels made from corn oil, you know, scoring four in
9 the current regime, or used cooking oils ranging from 11
10 to 18.

11 The lower pricing that we're seeing in the
12 marketplace is going to disincentivize some of that
13 importation. If this continues, I think you'll see the
14 numbers at the lower end of that spectrum as far as
15 what's going to get consumed in California.

16 There is a possibility that the EPA will -- when
17 they finally issue their ruling on the RFS volume
18 obligations that may push up the alternative biofuels --
19 I'm sorry, advanced biofuel volume requirements that
20 would drive up RIN values and perhaps, in that sense,
21 incentivize some additional blending.

22 But what really drives the flow of fuel into
23 California is LCFS.

24 This is sort of something that I've seen come
25 out of some CEC staffers, that it's a kind of a forward

1 looking view of what -- if we look at what's likely to
2 deliver the lion's share of the GHG reductions in the
3 next -- this went out to 2020. And I think this slide
4 was done about a year or so ago.

5 The CI values that it assumes, this was sort of
6 a -- you know, taking what's currently happening and
7 just projecting it linearly. You know, think of it as
8 business as usual or sort of the status quo projected
9 forward and it doesn't factor in, perhaps, you know,
10 large-scale deployment of cellulosic biofuels.

11 Although, from what I've seen and what I
12 continue to see, and that's something our company looked
13 at pretty closely about five years ago, I don't see it
14 coming in the next six to ten years on any meaningful
15 scale.

16 You'll see that, you know, a lot of the -- it's
17 at 85 percent. This assumed a blend of 85 percent
18 renewable diesel, 15 percent biodiesel.

19 But the alternative diesels make a pretty
20 healthy dent in the GHG or account for a large share of
21 the GHG reduction.

22 You know, these are some of the current
23 feedstocks. We talked about vegetable oils. I'm going
24 to show you another slide here in a minute that will
25 show kind of how that's changed a little bit.

1 These are the current types of waste and second
2 use feedstocks. Last year's production in the United
3 States, the 1.8 billion gallons, kind of broke out
4 according to this pie chart as to what the raw materials
5 were.

6 The interesting thing is that in 2008, five
7 years before, soybean oil was 90 percent of all the
8 biodiesel. And in 2008 biodiesel production was about
9 700 million gallons.

10 So, as the market's gone from 700 million to 1.8
11 billion, soy has actually gone up with it, but it's
12 share of the market so to speak has declined pretty
13 dramatically.

14 And it's really, I would say, the biggest change
15 has been the use of used cooking oils and yellow grease,
16 which is just kind of another term for used cooking oil,
17 but that purple slide.

18 And corn oil is something that, you know, really
19 didn't exist in the marketplace three or four years ago
20 as far as a byproduct coming out of ethanol plants.

21 Right now biodiesel's probably taking up no more
22 than 20 percent, tops, of the amount of corn oil that's
23 being produced. And the amount of corn oil that's being
24 produced, if you take the 14 billion or so gallons of
25 ethanol, about 70 percent of that today has corn oil

1 coming out the back end as a byproduct.

2 And I would say within two years it will be
3 close to 100 percent.

4 And that corn oil, I mean volumetrically it
5 works out to about -- I think it's about 6 or 7 percent
6 of an ethanol plant's ethanol production ends up -- or
7 that's the volume of corn oil.

8 So, if you have 14 billion, 6 or 7 percent of
9 that is corn oil.

10 That is typically a high free fatty acid
11 feedstock. Not all biodiesel plants can run it, and
12 that probably accounts for why the number's not bigger,
13 but I think it will play a bigger and bigger part in the
14 market landscape.

15 Which for California, in its GHG reduction goals
16 is a good thing given how the current scoring works.
17 It's the lowest CI fuel available in any meaningful
18 quantity.

19 You know, these are some of the things that I
20 think we're going to start seeing, at least in the world
21 of alternative diesels that you will see biodiesel being
22 made from.

23 And I would agree with Nathan that, certainly,
24 the brown grease -- I mean if you look at fats and non-
25 vegetable based, you know, the widely kind of touted

1 number within California is about 100 million gallons of
2 animal fats, used cooking oils. I don't know if that
3 actually includes brown grease, which is another term
4 for trapped grease.

5 Does it, Nathan, do you know? It's pretty -- I
6 mean it's not a huge quantity. It's somewhat an
7 untapped resource because most of it goes to landfill
8 today and I don't think the market really knows how much
9 of it is being generated.

10 Tall oil fatty acid comes from the paper
11 industry. You know, California has a huge volume of
12 dairy cows in particular, also beef cow, a lot of that
13 ends up as a type of animal fat that doesn't -- we call
14 it dead stock, it's fat rendered from dead animals that
15 could be utilized for fuel production that generally
16 isn't today.

17 The palm-based oils, these are not the oils that
18 are for edible human consumption. I mean the sludge
19 oils and the fatty acid distillates are sort of the
20 waste byproducts of the palm oil industry.

21 But as noted here, there's some pretty
22 significant concern about what that means in terms of
23 overall, you know, deforestation, et cetera, and what
24 that means environmentally and from a GHG perspective.

25 But it is available currently in large

1 quantities in terms of what's already in the
2 marketplace.

3 They all have very high FFA.

4 And that leads to they also have some other
5 undesirable compounds, but you need new processing
6 technologies to deal with it.

7 And these technologies are out there. There are
8 commercial scale plants employing each one of these
9 technologies operating in -- there's a couple in the
10 United States, in Asia and Europe using -- I mean,
11 you're going to use one or the other. You don't use all
12 three or a combination of the two.

13 They all are achieving the same ends, just a
14 different path to get there.

15 We, as a company, have been looking at some of
16 these with an eye towards, you know, using these types
17 of feedstocks, the brown grease and the dead stock
18 animal fats that are available here.

19 They each kind of have advantages and
20 disadvantages. I won't get into that today. I didn't
21 think that was what Jim wanted to dive into.

22 But my point is that the technologies are not
23 something that is at the lab scale. They're beyond
24 pilot. They're in commercialization.

25 They tend to have, for the most part, higher

1 capital costs. In some ways it might be capital cost
2 neutral relative to putting up a brand-new biodiesel
3 plant. Renewable diesel, unless you have an existing,
4 you know, unused refinery facility that has a spare
5 hydro-treater, you know, that's a \$40 million piece of
6 equipment if we're to build it new.

7 It's probably cheaper from a capital cost basis,
8 compared to renewable diesel.

9 So, I think these technologies are something
10 we're going to see more and more of in localized
11 markets. They're not going to -- and I agree with
12 Nathan that, you know, some of these new waste-based
13 technologies, if you pull palm oil or palm-based
14 byproducts out of the picture this is not going to solve
15 all the -- it's not going to meet the demand to get to
16 the GHG reduction goals of, you know, 10 or 20 percent
17 all by itself.

18 I mean I always -- my friends think renewable
19 fuels, hey, that's so cool, it's great what you're
20 doing.

21 But it's a scatter shot sort of -- there's no
22 silver bullet, it's a silver buckshot.

23 The trick is to come up with policy and why
24 we're here, to try to come up with policies that can
25 sort of incentivize the development of multiple things

1 simultaneously.

2 I think it's different to try to pick the winner
3 because there isn't a single winner. And it's an
4 evolutionary path and there are things we need to do in
5 the short and medium term and things we need to invest
6 in for the longer term.

7 And I think Nathan's slides kind of speak to
8 some of that.

9 I kind of hit all these points already, so I'm
10 not going to reiterate them, and I will say thank you.

11 MR. MC KINNEY: Great, thank you very much
12 Harry.

13 Commissioners, do you have any follow up?

14 COMMISSIONER SCOTT: I did have one question on
15 slide eight, where you had the pie chart with the ratio
16 of soybean oil. And you mentioned while you were
17 talking, and I think I wrote it right, but I just wanted
18 to check, it was the overall total in 2008 was 1.7, was
19 it? And in 2013 it was 2.2?

20 MR. SIMPSON: You mean total biodiesel
21 production nationally?

22 COMMISSIONER SCOTT: Yes.

23 MR. SIMPSON: In 2008 it was 700 million.

24 COMMISSIONER SCOTT: Oh, I wasn't even close,
25 700 million, okay.

1 MR. SIMPSON: In 2013 it was 1.8 billion.

2 COMMISSIONER SCOTT: 1.8 billion, glad I asked.

3 And then do you think overall that this trend
4 will continue where you use the soybean oil becoming a
5 smaller percentage of the overall pie?

6 MR. SIMPSON: In general, yes. I mean I think
7 some of it has to do with what happens with federal
8 policy with respect to RFS and the RVOs, and whether
9 advanced biofuels and biomass-based diesels, which
10 includes renewable diesel, you know, whether those
11 numbers stay static. They actually lowered advanced
12 biofuels in the draft and kept biomass-based diesel the
13 same.

14 I'm expecting, I think a lot of people in the
15 industry are expecting some changes in the final ruling.

16 So, assuming there is some growth in overall
17 national production driven by RFS, I mean just the
18 bottom line economics are driving this pie chart and the
19 change -- you know, how this pie chart would have looked
20 in 2008.

21 I mean today, unless you're ADM or Cargill, and
22 you're a fully integrated soybean oil crusher, if
23 someone like our plant had to go out and purchase
24 soybean oil today, looking at where biodiesel is selling
25 at or renewable diesel's selling at, nobody could make a

1 profit. We'd all lose money.

2 Given the lower RIN values and LCFS values, I
3 would say this quarter, this past quarter and into April
4 and May, very few biodiesel plants nationally will make
5 money. Almost everyone is losing money.

6 You know, and we expect that for -- it's the
7 vicious, kind of volatile nature of the market. I'm
8 glad I spent seven years as a foreign exchange
9 derivatives trader, it prepared me for it.

10 But the economics drive that pie chart. And the
11 other raw materials are significant -- the waste-based
12 raw materials are significantly cheaper.

13 And so, you're going to see the investment in
14 those technologies and that will drive -- and the
15 emergency of corn oil, which is a little more expensive
16 than used cooking oil, but not as expensive as soybean
17 oil, that's the other big one.

18 COMMISSIONER SCOTT: Thank you, another
19 excellent presentation.

20 MR. MC KINNEY: Yeah, I echo that, very, very
21 informative, Harry.

22 I also had a follow-up question. You mentioned,
23 briefly, the people purchasing your product, and I think
24 you mentioned the major, some of the majors as a blend
25 stock, some of the jobbers and perhaps some truck stops.

1 In your view, what do you see as the potential
2 for sales growth in each of those areas and do you see
3 one kind of becoming predominant over the others?

4 MR. SIMPSON: It's already sort of -- I would
5 say major oil has already become sort of the predominant
6 player in the marketplace if you look at volumes. And
7 the truck stops have -- you know, the truck stops are
8 opportunistic. And likewise with some of the jobbers in
9 that they're not necessarily mandated.

10 To the extent that the LCFS obligation can be
11 transferred and, you know, is kind of forced downstream,
12 some of those guys -- some of the fuel jobbers are
13 blending.

14 But I know of fuel jobbers who have said, you
15 know, we're not going to buy at the pipe anymore. We're
16 going to pull out of the terminals and, you know, we'll
17 just change the way we do it, and because they don't
18 want the obligation.

19 I would say major oil, for sure, is the dominant
20 player. And the truck stops, you know when the market's
21 right in terms of RIN values and LCFS credits, you know,
22 they can blend at a pretty large scale.

23 Renewable diesel, you know, I think that's going
24 to be a much bigger player and the truck stops will
25 leverage that. They do in a pretty big way when they

1 can, as it is, and I think we'll see major oil use that
2 a fair bit, too.

3 MR. MC KINNEY: Well, again, thank you very
4 much, Harry, and I know you had a long drive up from
5 Bakersfield today, so we really appreciate your taking
6 the time to come up and share your thoughts with us. So
7 thank you.

8 Our next speaker is representing Edeniq, which
9 is also a grantee of the ARFVTP. Tom also had a long
10 drive this morning.

11 So, Dr. Thomas Griffin is the Chief Technology
12 Officer at Edeniq, and he's overseen R&D, scale up,
13 engineering, technology optimization and intellectual
14 property since 2010.

15 Prior to his work there he's worked at Shell,
16 Molten Metal Technology and DuPont.

17 He also co-founded Pennsylvania Sustainable
18 Technologies, which integrated biological and chemical
19 reaction engineering elements and advanced biofuels
20 processes.

21 He has a BS, MS, and Doctoral degrees in
22 Chemical Engineering from MIT, and has also served in
23 the U.S. Navy.

24 So, thank you very much for -- I know you're
25 very busy and your firm's very busy, so thank you, Tom,

1 for making the time to come and share your thoughts with
2 us.

3 MR. GRIFFIN: Thank you for those kind words,
4 Jim, and also thank you for the invitation today. This
5 is a great forum and I appreciate being included.

6 I'm going to -- I've looked at the broad list of
7 questions that the Commission asked and I've decided to
8 focus in on really three of them.

9 And that is, what is the opportunity and what
10 are the challenges?

11 And I'm going to be pretty direct about what
12 some of the challenges are that we're working on.

13 And then the broad question of where can the
14 Commission continue to help?

15 So, the opportunity is somewhat simplistically
16 captured here by the picture of the RFS. You're all
17 well-familiar with that. And I didn't want to dwell too
18 much on the numbers, the year-to-year numbers and
19 category-to-category numbers, but the broad
20 opportunities, the gap between the current production
21 capacity of 14 billion gallons a year ethanol and the
22 target to add an additional 16 billion by 2022.

23 When this law first came out we all kind of felt
24 that was far off and it's not far enough anymore and
25 we're far behind on that.

1 This captures, though, the opportunity. The
2 opportunity for companies like Edeniq, if we can come up
3 with cost-effective and robust technologies, so a little
4 bit of a breakthrough is needed for that.

5 The alternative, really, is not a pretty one and
6 that's imports. And that's starting to take shape and
7 that's the alternative that we're trying to work to
8 avoid or to move back on.

9 So, just as a primer on this one chart, first
10 generation sugars or the really easy to ferment sugars
11 are from corn and sugarcane primarily.

12 I'm trying to work this point here, so give me a
13 slide or two to get used to it.

14 And these are broadly C6 sugars ISA categories.
15 They're easy to extract and ferment, they are in starch
16 form largely, or in sugar form already and can be easily
17 converted over to ethanol.

18 The more recalcitrant materials are the
19 cellulosics or fiber, and what I'm calling the
20 structural sugars is what I'm calling the feedstock
21 potential of those materials in fibrous biomass.

22 And this is what Edeniq and other companies in
23 our space are after.

24 Here, converting the structural carbohydrates
25 into sugars goes through a couple of steps and they are,

1 in general, hard to extract because of that chemistry,
2 more recalcitrant and, therefore, the sugars or ethanol
3 from them is less available.

4 And yet hardest is the C5 sugars. And I'm not
5 going to talk more about that distinction, but I can if
6 someone would like to afterwards.

7 I learned a lot from the last two talks about
8 respectfully disagreeing with maybe the pessimism
9 that -- the number collected around cellulosics or maybe
10 the time frame is a better way to say it.

11 This is an actual projection based on the pilot
12 plant and demonstration-scale performance that Edeniq
13 has seen to date in projection into full scale
14 commercial operations.

15 And this shows you that it doesn't have to be a
16 food versus fuel competition, or even a strand between
17 the two.

18 The feedstock costs for cellulosic sugars or
19 nonedible feedstocks can already be significantly lower
20 on the per pound of sugar, the penny to five cents per
21 pound of sugar operating cost for cellulosic sugars.

22 And I will explain -- you know, we are not
23 there, yet, but we believe we've demonstrated the
24 fundamentals to be there. That's just the feedstock
25 costs, excuse me, and then over here the all-in price of

1 the sugars south of 12 cents a pound. That's extremely
2 attractive relative to existing costs.

3 We're already making traction with those
4 process elements and engineering of those processes with
5 two customers right now overseas, and we hope to be able
6 to do the same in the United States, and really hope to
7 be able to do the same in our native State, here.

8 So, these are the challenge areas that I will
9 identify, there are seven of them. And for each one of
10 those I'm going to take just one or two charts and
11 explain what the challenges are and why we see those as
12 challenges, and what we're doing about it, and what we
13 think the industry should continue to do about it.

14 The seven are in these four categories. First,
15 the cost areas is just broad costs around capital, I
16 already mentioned that a little bit.

17 The two biggest operating costs are feedstocks
18 and enzymes, or catalysts in some technologies.

19 And then process technology limitations in terms
20 of conversion and purity.

21 The feedstock controversies, competition with
22 food, we've already -- I've already mentioned that, I
23 will come back to that.

24 And then the last I'm actually not going to
25 spend much time on, other than to acknowledge it, and

1 it's been a struggle for us in terms of investment
2 readiness cycles. And this is an area where, really,
3 the support of the State is a big help because our
4 investors, their interests and their timelines wax and
5 wane, and that's the way it is in the whole space from
6 what I understand.

7 So, let me take them one at a time. I probably
8 should have numbered these. I'll lose track of the
9 number but I'm going to go down -- I'm going to go down
10 the list right here, the way that I had ordered them.

11 The high capital cost has really been a
12 struggling point for the industry. And I think that one
13 of Nathan's charts showed numbers of installed per-
14 gallon costs north of \$10 a gallon.

15 That's a little bit worse than I've seen. I've
16 seen a range from \$6 to \$10 for some large projects that
17 are being built or being engineered now, so it's a
18 little bit tough to understand that.

19 The big difference is those are green field
20 projects for the most part. Edeniq has adopted
21 throughout its technology suite a bolt-on, or using
22 existing equipment to the extent possible approach.

23 The project we are building in demonstration
24 scale right now, in Brazil, and we are engineering for a
25 scale up to 11 million gallons per year bolt-on is at

1 \$3.50 a gallon capital.

2 So, I didn't bring that chart. My business
3 development partners asked me to bring it and I didn't.
4 And when I heard that other chart I said I better make
5 the statement.

6 So, it's a little bit of a commercial but it's
7 more important than the commercial. But that is the
8 crux of reducing the capital cost is the bolt-on
9 strategy as a rollout of the core technology.

10 Development priorities for us in this space are
11 to increase the intensity of the reaction. And we
12 increase intensity by doing these two things, increasing
13 solid loadings and optimizing recycles.

14 The process engineering around the optimization
15 of recycles of reagents, both substrates and catalysts,
16 and enzymes, really is a critical piece of what we're
17 doing and a critical piece of the economics.

18 I show it here on the capital but, obviously, it
19 touches on the enzyme cost as well.

20 Recommendation for the Commission's involvement
21 is to foster partnerships to facilitate technology
22 linkages. And at the end, Commissioner, I'll try to
23 give an example of that where I'm really talking about
24 where, you know, two different spaces in the processes
25 perhaps the linkage between feedstocks and the front end

1 of our process where the partnerships that we're pursuing
2 are key, and we could use some help with that.

3 And then, also unit operations and process
4 equipment integration along the same lines.

5 This is a sketch of our bolt-on concept. This
6 is close to what we're doing in Brazil, but I wanted to
7 show a U.S. application so I changed it a little bit in
8 terms of some of the unit operations.

9 This is what we are actually engineering with a
10 major customer now. I think they were mentioned earlier
11 in the day. And engineering means we think this is
12 probably about two to three years off. So, there's the
13 pessimism in livestock that I respectfully disagree
14 with. I don't think this is eight years off. Maybe in
15 terms of hundreds of millions of gallons it is, but in
16 terms of the first kind of 10 million gallon deployment
17 it's pretty close, and that's based on our own process
18 and concepts.

19 This is a process on the left, and this is what
20 we call the bolt-on component, preprocessing and
21 pretreatment. And I'll talk briefly about this, which
22 is the centerpiece of our technologies.

23 The hydraulics or saccharification, and then
24 this integration of saccharification with separations is
25 key as far as being able to extract the most useful

1 product and continue the recycle of reagents.

2 The bolt-on says we're going to use existing
3 liquefaction fermentation and separations, or
4 distillation, primarily. And this is a huge piece of
5 the capital equation that we're working.

6 How to engineer that balance between what is
7 coming in, in this case, as the existing feedstock and
8 the nonedible or cellulosic supplement originally we
9 were engineering that from about a 4 percent inclusion
10 up to about a 30 percent inclusion.

11 Our Brazil project is at the top end of that, as
12 well.

13 How that is engineering is really core to what
14 we're developing in terms of meshing those feedstocks
15 into compatibility and fermentation.

16 The cellunator is something that we can talk for
17 a long time about, we're very proud of that. That was
18 really the foundation of our company six years ago with
19 building this for cellulosic ethanol and also deploying
20 it in corn plants.

21 What does it do? It does all six of these
22 things on the left. The ones I've highlighted in green
23 are probably the most important, right-sizing the
24 particles by breaking down large particles, but not
25 creating a lot of additional fines.

1 Shearing the fiber and shearing fiber really
2 exposes cellulose to enzymatic access.

3 And creating a high density or high solids
4 density, homogenous slurry which, again, from a reaction
5 engineering standpoint really makes the most efficient
6 interaction between the enzyme and the substrate.

7 And so we have deployed the cellunator
8 commercially in six different ethanol facilities. We
9 are deploying it now in our cellulosic. We have it in
10 our demonstration facilities, two of them in Visalia.
11 And also in the plant that I mentioned in Brazil, that's
12 being built currently.

13 So, we just received the end of last year the
14 first of two -- actually, hopefully, the first of three,
15 but two have been allowed now, the grant to that patent
16 gives us a right to practice that -- really, full rights
17 to practice that equipment in that space, and
18 particularly around both corn kernel fiber, which I'm
19 not going to talk about much today, and around
20 cellulosic deployment.

21 So, our partner, IKA, is a German company that's
22 U.S.-based in North Carolina and they've been a great
23 partner through the history of Edeniq and continue to
24 develop high shear mechanical equipment for these
25 applications.

1 Going to the second area, the high feedstock
2 costs, really we're looking for the combination of
3 logistics and chemistry.

4 So, on the chemistry side, the highest value
5 compositions and their consistency is very important.

6 Taking advantage on a logistics side of high-
7 volume aggregation availability, that is where bagasse,
8 as many of you know, has an advantage because of its
9 aggregation already as a sugar plant.

10 And then developing partnerships with expertise
11 in both of those areas. Our immediate development
12 priority is getting a deep knowledge, and I really
13 stress that, because we've learned some surprises in
14 this space, understanding the physical and compositional
15 variances of feedstocks and adapting our process
16 accordingly.

17 What we're asking the Commission is to again,
18 the same theme as the first one, facilitate process
19 integration partnerships.

20 And particular in this case, round the
21 agricultural side, the harvest protocols and pre-
22 processing operations to make feedstock applicable to
23 our process.

24 Part of the work that we're doing in sponsorship
25 under the program which many have tripped on the

1 acronym, and I'm not going to try, the program we enjoy
2 very substantial sponsorship from here is looking at
3 feedstocks. This was the front end and is the theme of
4 our process of being able to look at California
5 applicability of our products.

6 On our pilot and bench scale studies, and also
7 some economic studies, we've looked at all six of these
8 categories, and we may continue to look at more.

9 You know, this is a moving target in some ways,
10 but these are the main categories that we thought were
11 of interest.

12 The upshots are at the bottom here. I'm having
13 trouble with this. There we go.

14 California Stover really has the highest
15 potential as far as crossing both of those spaces. And
16 it has the potential to make cellulosic ethanol and also
17 to be available in high volumes.

18 Energy crop projects are interesting and
19 everybody has kind of mixed feelings about this. As far
20 as the actual output of the materials that we tested,
21 and we used some surrogates in this space, very high --
22 this is the highest ethanol yield that we had, that we
23 saw.

24 But I would say it has uncertain practicality
25 due to the land use issues and the competition for land

1 as far as dedicated energy crops go, and that's an
2 ongoing debate, but that is a real limitation of that
3 route.

4 Citrus wood is interesting. So, you know, being
5 in the south part of the Central Valley, and looking at
6 citrus on my way to work every day, and it's really
7 quite pleasant, right, this time of year with the
8 blossoms, the wood is everywhere, but the farmers don't
9 aggregate it the way that corn Stover farmers are
10 starting to do, and certainly the way some other large
11 energy crops are targeting.

12 As far as the chemistry of that wood, we got
13 some good results out of that. I would say it was the
14 third best on a list -- yeah, it was in that range,
15 along with some of the grain crops that we could
16 process.

17 But again, aggregation logistics are uncertain,
18 they're not really practiced in the scale that we need
19 them to be practiced in.

20 And then I'll just summarize other feedstocks
21 that are at the top of the list, the nut crop residues
22 and the grain crops. There are some limitations with
23 our cellunator on this point here that I didn't talk
24 about, but it's in the footnote there.

25 And the other nut crop residues, just by their

1 composition, have been disadvantaged.

2 The third area is the high enzyme and catalyst
3 costs. This is one of the two leading operating cost
4 limitations, along with the feedstock.

5 Our approach, as I alluded to already, is
6 engineering of process recycles to get increased
7 turnover numbers. Really try to squeeze as we can out
8 of reusing our enzymes.

9 We've also developed a series of additives that
10 we've filed patents on. These are commodity additives
11 that are not enzymes, but they enhance productivity and
12 partitioning of enzymes, and you can think of them as
13 surface agents.

14 And then we've also developed some core
15 competencies around analytics to really track where
16 specific enzyme classes are going with time and position
17 in our system. And that turns out to be a really
18 important core competency.

19 Demonstrating optimized enzyme deployment. We
20 have very specific price targets on enzymes and how we
21 get there through conversions and turnover numbers.

22 Demonstrating that on our pilot facilities is
23 really what we've focused on right now. We've done it
24 on a small scale, in some cases on a pilot scale.

25 Rolling it out in our demo scale in Brazil, next, is a

1 primary objective.

2 I'm asking that the State, really, but in
3 particular the Commission support, continue to support
4 deep analytical expertise. This is the core competency,
5 really, for what we're trying to do and what the
6 industry needs to do, the analytical chemistry.

7 And I'm putting in category two, that I know are
8 broadly applicable to us and to our competitors, and
9 also into probably the biodiesel space as well, so
10 things that the State can get a lot of value for the
11 money on.

12 And then fostering, really, world class, broadly
13 available again, enzymatic fundamentals, so both the
14 analytics and the enzymatic fundamentals.

15 There is a lot of that in the State. I think
16 Nathan's first chart was accurate on that point, but we
17 need to sustain that leadership.

18 This is just one example, as I will show, of
19 what we're doing as far as additives go. This is a
20 proprietary additive.

21 What's shown here, and this is the conversion of
22 C6. I'm not doing too many science charts today, but
23 wanted to do this one. It's clarification time.

24 In this range, 20 to 40 hours, this is really
25 the key range for our process and its effectiveness.

1 What's shown in the green diamond here is a low enzyme
2 dose without and additive, and so the conversion is
3 limited where you see it.

4 The same enzyme dose, now with the additive is
5 the diamond. We're getting at least a 40 percent
6 increase in effectiveness, and I look really at this
7 point right here as being what indicates what the
8 process can do in that time frame.

9 We went to a different enzyme loading and these
10 are different products, and I could talk about what they
11 are, but these enzyme loadings are based on their -- we
12 choose them based on their economics.

13 This is the unaided performance and, again, the
14 additive aids the performance by about 40 percent, both
15 in the very short time and even more so in the longer
16 time frame.

17 So, this is one of the kind of developments that
18 we're bringing to the table. It's taking cellulosic
19 economics, if you will, beyond where it has been in a
20 substantial way.

21 The fourth area is the conversion and this is
22 really my chemical engineering part of the talk. And
23 what Edeniq brings is intimate integration of
24 pretreatment and hydrolysis across the whole value chain
25 of the processing from the -- that is our core

1 competency in those two spaces, and continuous
2 processing.

3 We have engineered a reactive separation scheme
4 that removes the product continuously from the reactors
5 and allows the conversion to be driven much further as a
6 result.

7 And then, again, unused materials as well as the
8 reagents or enzymes.

9 So, that reaction engineering piece is core to
10 our offering and we believe it's core to making the
11 economics work.

12 Our immediate priority is to optimize the
13 operating space. And we look at conversion, purity and
14 throughput as the indices of merit versus the capital
15 requirements.

16 The recommendation for the involvement and
17 you'll see this is along the same kind of two things
18 that I said before. It's supporting a core competency.
19 In this case chemical reaction engineering expertise
20 which, again, the State does have, but has some value
21 particularly in biofuels and maintain.

22 And also extending -- this is an important one
23 that I want to stress today. Extending the feedstock
24 studies beyond the pure chemistry, and the economics and
25 the logistics into another space, and it's an

1 engineering space that I'll call rheology.

2 This is an area where there may not be a lot of,
3 I would say, sexy fundamentals to fun in terms of what
4 starter companies are patenting and bringing to the
5 table as new technologies, new fundamental technologies,
6 but it is critical to make these processes work, being
7 able to pump high solids, very viscous, very non-Newtonian
8 or even non-standard type of fluids in that rheology.

9 And this is something that we spend a lot of
10 time on in our company.

11 This is a picture of our continuous reactor.
12 I've said some of these things already, but just to
13 highlight, we've developed a continuous reactor. We
14 have cooperations with major enzyme suppliers, as well
15 as some of our own enzyme development.

16 And the enzyme enhancers or additives are done
17 or applied to increase activity and a lot of reduction
18 in loading.

19 These were our targets when we did some work
20 with the Department of Energy that I'll come back to on
21 a slide at the end, C6 conversion of 80 percent and C5
22 of 70.

23 We hit those targets with Stover. We have not
24 gotten there with the other feedstocks, yet, but we're
25 working to get there and a lot of it is around this

1 rheology management.

2 MR. MC KINNEY: Tom, if I can just do a friendly
3 time check, this is a great presentation but I'm a
4 little worried about time.

5 MR. GRIFFIN: Right.

6 MR. MC KINNEY: And I think you've got several
7 categories you still want to cover.

8 MR. GRIFFIN: I will accelerate. And I did
9 promise you that, Jim, so thank you.

10 Okay, and then some of the equipment
11 developments that we have around are both the reactor --
12 again, this has a lot of core internals for removing
13 products and then the filter system we call SmartFlow.
14 We have the rights to that technology for biomass
15 processing, as well.

16 The feedstock controversy, all I want to say
17 there is I've already really captured what the idea was.

18 What we would like to see -- let me just hit the
19 last line. What we'd like to see the Commission do is
20 to maintain the focus that you have on LCA and carbon
21 intensity. That is a holistic focus that I think you
22 bring tremendous value to the way we look at things and
23 those are the right ways to look at things.

24 All the feedstocks that we've studied, this is
25 just -- we took our bolt-on concept and now we've

1 deployed it.

2 In this design, for another feedstock, I didn't
3 name it here because one of our investors brought this
4 to us, but it has a combination of components that might
5 have some high food value, as well as a significant
6 component that doesn't, but have significant structural
7 carbohydrates.

8 And the combined process flow sheet will allow
9 us to optimize the output of those.

10 Am I done, Jim, or I get a couple more? Is that
11 okay?

12 MR. MC KINNEY: Yeah, if you can kind of go
13 through you last couple of slides quickly and, yeah,
14 thank you, Tom.

15 MR. GRIFFIN: So, this is a summary of what
16 we're asking, really, from the -- or what we're stating
17 the issues are around cost, process limitations and
18 feedstock controversies. I've touched on all of those
19 and how we think we can attack those.

20 The investment readiness cycle seems to still be
21 a question mark for us. We're finding interest in
22 private investors to wax and wane in ways that are
23 difficult to manage.

24 Support from the Commission, particularly the
25 ARFVTP has been really fundamental for us. It's

1 broadened the way we look at our technology, to be able
2 to go the continuous processing, to look at other
3 feedstocks, and we really appreciate that.

4 And I want to acknowledge our project manager
5 Akasa Carr (phonetic), for her diligence. She's been a
6 very helpful liaison with the Commission for us.

7 The ongoing support, I've captured it before,
8 but just to summarize, we'd like to see establishment of
9 sustained core competencies. I've named three areas
10 where we want to see that.

11 Facilitation of critical partnerships in the
12 value chain; we'd like to see the farmers in our valley
13 be more -- maybe more unified in their approach to
14 handling their residuals.

15 And if you could accomplish maybe motivating
16 that, that would be one thing in terms of critical
17 partnerships.

18 Attacking the toughest technical issues head on,
19 it may not always be the ones that are in the front page
20 of science, or *Scientific American*, but again, the high
21 solids and the rheology issues that we have and your
22 continued emphasis on holistic LCA evaluations.

23 This is why we come to work in the morning,
24 really to try to shift the emphasis of the energy
25 struggle -- juggernaut, I guess, of the oil companies

1 and oil countries, I should say, and get the maximum
2 value out of biomass and agriculture values,
3 particularly nonedible feedstocks that are ubiquitous.

4 And I, again, thank you for including me.

5 MR. MC KINNEY: Well, thank you very much, Dr.
6 Griffin that was very, very informative.

7 COMMISSIONER SCOTT: Indeed, thank you for that
8 very thorough presentation.

9 I didn't have any questions for you, per se, but
10 I really appreciated the focus on some specific ideas
11 for potential funding opportunities, potential
12 investments that the Energy Commission might be able to
13 make. So, thank you for including that in there.

14 MR. GRIFFIN: Thank you.

15 COMMISSIONER SCOTT: Thanks for coming.

16 MR. MC KINNEY: Yeah, thanks again, Tom.

17 MR. GRIFFIN: All right, thanks Jim.

18 MR. MC KINNEY: Well, we didn't really plan it
19 this way, but I think it's worked out very well, our
20 opening speaker was a former Commissioner here at the
21 Energy Commission and our closing speaker is also a
22 former Commissioner from the Energy Commission.

23 So, I'm very pleased to introduce Julia Levin,
24 who is currently serving as the Executive Director of
25 the Bioenergy Association of California, which is a

1 coalition of companies, agencies, and local government
2 and it's working to promote sustainable bioenergy or
3 biogas.

4 And Julia has served as Deputy Secretary for
5 Climate Change and Energy with the California Resources
6 Agency, where she Chaired Governor Brown's Interagency
7 Bioenergy Working Group, and lead development of the
8 California 2012 Bioenergy Action Plan.

9 She also worked with Attorney General Brown to
10 defend California's Feed-In Tariff and other clean end
11 policies.

12 And as I mentioned, she served as a Commissioner
13 here at the Energy Commission.

14 She's also had important positions with the
15 National Audubon Society and the Union of Concerned
16 Scientists.

17 She's a graduate of Hastings and then Brown for
18 her undergraduate work.

19 So Julia, welcome.

20 MS. LEVIN: So, hi everyone. Is this on?

21 All right, I must have done something really
22 awful in a past life because not only am I last on the
23 agenda today, I was last on the agenda yesterday, and I
24 was first on the agenda yesterday.

25 So, I feel like I must really have done

1 something bad.

2 In any case, as Jim said, the Bioenergy
3 Association of California is an association of local
4 governments, public agencies and private companies
5 working towards sustainable bioenergy development. And
6 our focus is actually on the organic waste piece.

7 So, a little bit of overlap with the previous
8 speakers, but also some differences.

9 I'd like to start with what the potential is for
10 organic waste to fuels in California and it's enormous.
11 It won't provide all of the liquid fuels. We need the
12 other technologies that the rest of the panel has spoken
13 about, as well. But it's a really important piece and
14 it's actually the lowest carbon piece by far.

15 So, California's a big state. We're the biggest
16 dairy state in the country. We're one of the biggest
17 timber states in the country, one of the biggest paper,
18 and pulp processing, construction and we make a lot of
19 organic waste.

20 We have over 500 wastewater treatment
21 facilities, 1,600 dairies. I don't remember the number
22 of landfills, but it's a couple of hundred landfills, I
23 think, almost 300 landfills in California.

24 And we continue to put about 16 million tons of
25 organic waste into landfills each and every year.

1 Now, hopefully, that's going to change soon.
2 There's legislation pending that would require
3 commercial organic recycling, so from restaurants, and
4 grocery stores, and large producers of organic waste.
5 Hopefully, that will pass this year. If not, the
6 CalRecycle and the Air Board have said they're going to
7 do it administratively.

8 But at least for now we continue to put a lot of
9 organic waste into landfills.

10 If you put just the organic waste together, the
11 biomethane emissions from that waste could generate 500
12 million to half a billion gallons of very low carbon and
13 carbon negative fuels per year.

14 So, 500 million to a billion gallons of low
15 carbon and carbon negative transportation fuels per
16 year.

17 The benefits from this are enormous. I mean the
18 benefits of all renewable fuels are enormous and I don't
19 want to say that they're not all important. So, I
20 hope -- I'm not going to keep repeating that, but I hope
21 that's clear. We need it all, just as we do on the
22 electricity side.

23 But on the fuel side, using organic waste to
24 create transportation fuels not only gives you a very
25 clean renewable fuel that's low or negative carbon, it

1 also helps to keep waste out of landfills, and it
2 protects air and water quality by reducing the
3 uncontained dairy waste, and emissions from wastewater
4 treatment facilities.

5 It will also help us to meet our landfill
6 diversion requirements and it creates jobs because it
7 will be done locally here, in California. The feedstock
8 will be from California and the fuels produced will be
9 used in California.

10 I'm going to focus on a couple of areas in a
11 little bit more detail just to give you a flavor for
12 what the potential here really is.

13 So, as I mentioned, in California we have over
14 500 wastewater treatment facilities, about half of which
15 are capturing and beneficially using their biomethane
16 emissions now.

17 There's a lot of potential for growth. Some of
18 those could be producing transportation fuels, instead
19 of electricity, and they could be producing a lot more
20 methane if they could digest food along with the
21 wastewater treatment, gas and biosolids.

22 So, the potential, depending on whether there's
23 co-digestion or not for wastewater treatment facilities
24 is about 50 to 150 million gallons a year.

25 These are, according to the Air Resources Board,

1 the lowest carbon fuels in existence. If a fuel, if a
2 transportation fuel is produced from a large wastewater
3 treatment facility, it would be negative 65 grams per
4 megajoule of energy, negative 65. That's a 200 percent
5 carbon reduction from traditional fossil fuel, from
6 diesel or gasoline. It's astonishing, you know, that it
7 could be that far carbon negative.

8 Even from a smaller wastewater treatment
9 facility it would -- got to check the numbers -- about
10 11 grams per megajoule, so still very, very, very low
11 carbon.

12 The potential from other organic waste sources,
13 I'll just run through these quickly. So, diverted
14 organic waste, that's food, fats, oil and grease, yard
15 waste, things like that could produce 168 million
16 gallons a year.

17 Landfill gas could produce 121 million gallons a
18 year. And dairy waste can produce 184 million gallons a
19 year.

20 This is all from waste. This isn't growing
21 anything. This isn't having to produce something new,
22 it's using waste that's already available.

23 So what are the challenges to this? Well, the
24 slide on the top is supposed to symbolize lawyers, and I
25 can say that because I am a lawyer.

1 But really, I think for organic waste to energy
2 the technology is largely proven. That's, for the most
3 part, not the barrier.

4 We do need monitoring equipment. We need it at
5 a size and commercial price that will work in the field,
6 especially with the very stringent new pipeline biogas
7 standards that the PUC has adopted.

8 But the technology to produce transportation
9 fuels from organic waste is already in existence, it's
10 well proven, it's being used all over the world.

11 The challenges are much more on the legal and
12 financial side. There are too many challenges to the
13 LCFS and the Federal Renewable Fuel Standard, and that
14 creates a lot of uncertainty in the market, in addition
15 to regulatory changes.

16 One of the producers of low carbon fuels,
17 yesterday at a conference in San Diego said he'd much
18 rather have a bad rule and have it stay in place over an
19 extended period of time than have the rules continue to
20 change. And I see head nodding here at the desk.

21 The uncertainty in the market is crippling for
22 this industry, as I think it is for many of my
23 colleagues.

24 Pipeline access and costs is another huge
25 problem. We have new pipeline biomethane standards in

1 California which, for the first time in decades, opened
2 it up to landfill gas, but are a step backwards for
3 every other kind of biogas.

4 They are far and away the most stringent
5 standards in the world and they will be difficult or
6 impossible to meet for financial reasons, not because
7 they're not possible technically. Although, even
8 technically we're sort of at the outer limits of
9 detection capabilities for some of the constituents of
10 concern that California's now asking biogas producers to
11 test for.

12 In addition, blending, which is likely the only
13 way that we'll be able to meet the minimum Btu requires
14 from the PUC, we're not sure that the fossil fuel
15 natural gas that would have to be blended with the
16 biogas will meet the other requirements that are now
17 imposed on biogas.

18 So, there are multiple layers of irony. The new
19 standards are the result of legislation that was
20 actually supposed to facilitate injection of biomethane
21 and we think that, unfortunately, they're going to make
22 it harder.

23 Having said that, the PUC is just beginning the
24 second phase of the proceeding and they will discuss
25 cost allocation, and interconnection. And we're hoping

1 that in this phase, at least, the PUC recognizes the
2 very broad benefits of increasing biomethane and
3 actually allocate costs accordingly.

4 In addition, challenges include outdated rules.
5 And I'll pick on my former employer here at the Energy
6 Commission, things like minimum production levels. When
7 you're talking about organic waste, it's a very
8 distributed form of energy. You need to put the
9 facilities where the waste is and that will depend on
10 the size of the dairy, or the wastewater treatment
11 facility, or the food processing plant.

12 So what might be a reasonable commercial scale
13 facility for ethanol or biodiesel, it's going to be too
14 big for virtually all organic waste to fuels production.

15 The largest one in California right now is the
16 Altamont Landfill that's producing 13,000 gallons per
17 day of liquefied natural gas. Actually, it was thanks
18 to funding from the Energy Commission.

19 That wouldn't meet the minimum standard in some
20 of the recent grant solicitations from the Energy
21 Commission.

22 So, the rules need to be adjusted to account for
23 the reality of organic waste to fuels.

24 CalRecycle also has a bias against gasification.
25 While we're thrilled that they're going to have Cap and

1 Trade revenues available soon, they're limiting it to
2 anaerobic digestion.

3 There are multiple technologies to convert
4 organic waste to transportation fuels and we should be
5 looking at all of them. We shouldn't be choosing
6 winners and losers at this point, we should just be
7 setting the standards.

8 Permitting is also very challenging, particular
9 in the South Coast, although less so, I would say, on
10 the transportation side than on the electricity side.

11 That's all the negative part. There are a lot
12 of positives. We are thrilled that the Energy
13 Commission has another ten years of funding under the
14 acronym that none of us can remember, so I will continue
15 to call it the AB 118 program.

16 It's \$100 million a year. That's not enough,
17 but it's a good start, and especially if it really does
18 prioritize the lowest carbon fuels, which start with
19 organic waste to fuels.

20 AB 1900 was supposed to help the development of
21 biogas. We'll see what the second phase of the
22 proceeding does.

23 Cap and Trade revenues are a very important
24 opportunity to promote waste to fuels.

25 In addition to the money at CalRecycle, the

1 Department of Food and Agriculture has \$20 million for
2 dairy digester and other development in the food and ag
3 sector that could go to produce transportation fuels.

4 And then the California Department of Forest and
5 Fire has \$50 million, some of which could go to produce
6 fuels from forest biomass that's collected to reduce
7 wildfire risks.

8 I mentioned the legislation to require recycling
9 of commercial organics recycling, and then I'm going to
10 come to the last one in a moment.

11 So, on AB 118, Commissioner Scott, you have \$100
12 million to play with, but only \$6 million is going to
13 the lowest carbon fuel, organic waste to biofuels.

14 We think that that's not the right proportion
15 giving that ARF -- the lowest carbon and cleanest fuels
16 available.

17 So, we're hoping in future years, future
18 solicitations that that will be a larger proportion of
19 the funding. That's out of the \$20 million for the
20 larger biofuels category.

21 There are other categories of funding that can
22 help to promote organic waste to fuels, but that's the
23 one that is the most obvious.

24 I've mentioned the pipeline bio standard. So,
25 last, but not least, we are sponsoring legislation this

1 year that addresses some of the problem that I think
2 both Nathan and I'm sorry, I've already forgotten the
3 second gentleman, your first name?

4 MR. SIMPSON: Harry.

5 MS. LEVIN: Harry, sorry. That Nathan and Harry
6 both mentioned the volatility in the low-carbon fuel
7 standard market and the RIN market. This is really
8 critical to fix and to provide more long-term certainty
9 for the industry to develop these fuels.

10 Speaking just for organic waste to fuels, these
11 require long-term investments, or investments with long-
12 term paybacks to build the infrastructure to convert
13 wastewater treatment biogas, or biosolids, or dairy
14 waste to transportation fuels.

15 Investors are not going to make those
16 investments unless they feel that there's long-term
17 certainty about the value of the investment and the
18 return on the investment.

19 So, we're sponsoring legislation that would
20 establish what we're calling a green credit reserve that
21 would allow the State, or whoever runs the reserve to
22 buy -- or to contract to buy low carbon fuel credits
23 when a project is in development that would give the
24 project developer certainty that there will be a market,
25 and what the price will be.

1 The State will actually be on the hook to pay
2 for the credits until they're generated. So, unlike a
3 loan guarantee program, or even a grant program, if the
4 project goes under during the development phase, which
5 is the most likely period for it to go under, the
6 State's not on the hook for anything. The State doesn't
7 have to pay a penny until the fuel is flowing and the
8 credits are generated.

9 But it does provide some certainty and some
10 stability to the market, and something that developers
11 can bank on.

12 And so, we made it out of our first committee
13 earlier this week. We're looking for more support for
14 this legislation. We think it's going to make a big
15 difference in the market and help to move all of these
16 low carbon fuels forward.

17 And I think I'm done. I tried to go quickly.
18 Hopefully, I stayed on my time limit. I'm happy to take
19 any questions.

20 COMMISSIONER SCOTT: That was another excellent
21 presentation and a terrific close. So, we're happy to
22 have you there.

23 And I just -- I don't have any specific
24 questions, but I did also want to say thank you, to you,
25 for inviting me down earlier this week to do a

1 presentation at the Biocycle Conference. I really
2 enjoyed the opportunity to meet all of the folks who are
3 working on the projects in this space, and to be able to
4 highlight some of the things that the Energy Commission
5 has also helped to fund.

6 So, thank you for that, I enjoyed that and your
7 terrific presentation here today.

8 MS. LEVIN: People loved hearing from you.

9 MR. MC KINNEY: Yeah, also thank you very much,
10 Julia. We really appreciate you closing out today's
11 panel sessions with a very informative presentation, so
12 thank you.

13 And with that, again, I just want to thank each
14 of the four panels today. You all just had really, very
15 informative presentations, so thank you so much for
16 taking the time to come up here and present with us
17 today, so thank you.

18 (Applause)

19 MR. MC KINNEY: So, should I turn this over to
20 you, Heather?

21 MS. RAITT: Sure. So, now we move on to public
22 comments and we'll start with folks in the room before
23 going to WebEx.

24 COMMISSIONER SCOTT: Terrific. And if you have
25 a blue card, please be sure to give it to Heather or

1 Lynette so they can get it to me.

2 Our first public comment will be from Kim, I
3 don't know how quite to say her last name, Heroy-
4 Rogalski, who is at the California Air Resources Board.

5 MS. RAITT: If you can go to the podium, and if
6 you have a business card you can give it to our court
7 reporter.

8 MS. HEROY-ROGALSKI: Can you guys hear me? You
9 did a heroic job with my very long last name, by the
10 way.

11 And I wonder -- I talked to Jim ahead of time, I
12 think I can do this in four minutes. Three might be a
13 little quick. Oh, I'll try, knowing that everyone's
14 been sitting here a long time.

15 MR. MC KINNEY: Just so the Commissioner and
16 Heather know, since we work so closely with the Air
17 Board and this is an important area, so I offered her
18 more than the three-minute kind of standard time.

19 MS. HEROY-ROGALSKI: But I'll try to talk fast.

20 Okay, I'm Kim Heroy-Rogalski. I'm in one of the
21 groups at ARB's Mobile Source Control Division, so
22 thanks for making time to hear from us today.

23 As you heard and as Jim introduced earlier, and
24 as you well know, the State is facing huge challenges in
25 reducing both criteria pollutants, like oxides of

1 nitrogen and greenhouse gases at the same time. And
2 this is something that ARB is really grappling with.

3 I mean, traditionally, we've been looking at
4 reducing NOx and hydrocarbons to get ozone down and to
5 get ambient particulate matter down.

6 And lately, we've been trying to think, well,
7 how do you do that and at the same time meet the State's
8 really aggressive goals to get greenhouse gases down to
9 80 percent below 1990 levels by 2050.

10 And it's a tricky challenge. And a lot of folks
11 today were talking about trying to get lower NOx
12 vehicles out there and that's something that ARB is
13 really interested in, and something that's going to have
14 to happen if we're going to get NOx down by more than 80
15 percent beyond the gains we've already made.

16 What's been achieved so far in reducing NOx is
17 really impressive, but we do need to go a lot further if
18 we're going to achieve air quality standards in South
19 Coast and San Joaquin.

20 So, that's one that the ARB's really looking at
21 and we're trying to look at how you address both of
22 those simultaneous.

23 And so, two of the ways that we're trying to
24 wrestle with simultaneous challenges are, one, in
25 developing the next round of State implementation plans

1 for ozone standards for the South Coast and San Joaquin.
2 And one in developing something new called our
3 Sustainable Freight Strategy, in trying to look at how
4 you reduce emissions from every source associated with
5 moving freight in California.

6 Okay, and so to support those two main planning
7 efforts, ARB's recently started a sort of mobile source
8 technology assessments. And it's really those that are
9 the reason that I'm here to talk to you guys today
10 because they overlap a lot with a lot of the topics that
11 you guys are addressing as part IEPR.

12 So, the technology assessments are focused on
13 the following mobile source sectors; heavy-duty trucks,
14 locomotives, ocean-going vessels, commercial harbor
15 craft, harbor handling equipment, airport related
16 sources and transportation fuels.

17 And our goal in doing these assessments is to
18 look at a comprehensive evaluation of the current state
19 and projected development for the next five to ten years
20 of mobile source control technologies for those sectors.

21 We're looking at how vehicles and equipment are
22 used in each sector, how fleets currently purchase and
23 manage their vehicles, what technologies are available
24 and what infrastructure needs they each have.

25 We're looking at what demonstration and pilot

1 projects have been conducted and what ones need to be
2 done.

3 We're looking at costs and we're looking at
4 well-to-wheel emission rates.

5 And so, the reason that we're doing all this is
6 to try to put together all the information that we have
7 internally and so we can take advantage of outside
8 expertise and reports that have been published to try to
9 come up with how we can best encourage commercialization
10 of key technologies.

11 Then we're hoping that will inform our freight
12 plan, our SIPs, what regulations we plan to do over the
13 next decade, and as well help us inform how we spend our
14 pots of incentive monies.

15 So, we're working on this and we're just
16 starting to work on this as you guys are talking about
17 this, and I wanted to make sure that you knew we were
18 working on it.

19 We're doing the technical work now, and we hope
20 to have a series of workshops this summer. We're going
21 to couple that with the public process that's going on
22 as part of our Sustainable Freight Strategy.

23 So, we anticipate workshops this summer and
24 we'll be wrapping up the technical assessments in
25 October of this year.

1 We've been working -- we've set up teams at ARB
2 to work on this and we've reached out to the local air
3 districts, including the South Coast, San Joaquin and
4 the Bay Area, and they're contributing staff to help us
5 work on these, as well.

6 We are just getting started, but we'd like to
7 reach out to you guys, as well, and take advantage of
8 the expertise you have at CEC.

9 So, we're hopeful that that can be set up
10 because the work that we're doing really complements the
11 work that you guys are doing. The kinds of decisions
12 we're facing are the same ones that you are.

13 So, our hope is that we can coordinate with you
14 guys so the IEPR and the ARB Planning and Assessment
15 efforts are consistent and aligned.

16 Anyway, we really appreciate you reaching out to
17 us, Jim, and we've worked together closely in the past
18 and hope to continue to do that.

19 And if you have any questions about the
20 technology assessments, either now or later, feel free
21 to talk to me.

22 And we will also put this into a nice letter
23 form and submit it to your docket.

24 Okay, thank you.

25 COMMISSIONER SCOTT: Thank you very much for

1 that.

2 Our next comment is from Mike Waugh, also from
3 Air Resources Board.

4 MR. WAUGH: Thank you, Commissioner Scott. This
5 was, in fact, a very informative workshop. Thank you
6 for that.

7 I am the Chief of the Transportation Fuels
8 Branch at ARB, the owner and operator of the Low Carbon
9 Fuel Standard.

10 So, all of these fuels here today, these low
11 carbon fuels are really necessary for the success of the
12 program.

13 So, whether it's hydrogen, electricity, natural
14 gas, biomethane, liquid biofuels, they're all needed for
15 the success of the LCFS.

16 I wanted to address one item and it was brought
17 up, I guess, a couple of times with this panel. There's
18 a misunderstanding with regard to what has happened to
19 cause the LCFS credit prices to drop.

20 A lot of people think it's the ARB has frozen
21 the standard in place and that's not true. The 5th
22 District Court of Appeal did that. Last year they made
23 a ruling that they had some issues with the CEQA with
24 regard to the way the LCFS was adopted.

25 Actually, it's more than just the LCFS, it's the

1 way ARB was adopting their regulations. So, we've
2 completely changed how we do that.

3 They could have set the LCFS aside, and the good
4 news is they didn't. The bad news is that they said
5 until we address the issues that the court had, through
6 a complete rulemaking and re-adoption of the LCFS, that
7 the 2013 standards be frozen in place.

8 So, the pause button that we're all experiencing
9 right now with the LCFS at one percent carbon intensity
10 reduction, that pause button was pushed by the 5th
11 District Court of Appeal.

12 Now, to have a full public process and to also
13 recommend to our Board, I think very important revisions
14 to the LCFS, it takes time.

15 We've already had four workshops. We've got two
16 more workshops next week. So, we're moving at a pretty
17 fast pace to get something done this fall.

18 The complete rulemaking, of course, as you know,
19 doesn't end when we take it to the Board. We end up
20 having to go back to the Board a second time and do our
21 final statement of reasons.

22 And so, it's pretty clear that the rulemaking
23 process won't be completed until sometime in 2015.

24 And so, it appears that the one percent pause
25 will occur for 2014 and 2015. And I think, because of

1 that reason I think there has been a falling off of LCSF
2 credit prices.

3 Now, as my staff looks forward to looking at
4 what the proposed 2015 curve looks like, and we do the
5 analysis that includes these fuels, that these are very
6 important, we need to look at 2016 through 2020, and
7 post-2020, maybe to 2030.

8 So, I would just like to just, you know, address
9 some misperceptions with regards to why we're in the
10 situation we are and we're looking to have a strong
11 signal coming out of 2015. Thank you.

12 COMMISSIONER SCOTT: Thank you.

13 Do I have any other blue cards for comments in
14 the room?

15 Okay, do we have comments on the WebEx, on the
16 phone?

17 MS. RAITT: Yeah, there's one person on WebEx,
18 and so we'll go ahead and open up the line.

19 Go ahead.

20 MS. NIGUERIEA: Hi, my name is Anna Nigueriea
21 (phonetic). I'm from Earth Jaxis (phonetic).

22 And I had a question about -- one about the
23 natural gas presentation that SoCal Gas gave. And was
24 wondering that since you're envisioning natural gas
25 competing with renewables how that competition

1 reconciles with, you know, the air pollution reduction
2 needs that were described in other presentations, and in
3 South Coast, and in Southern California in general?

4 And then I had one other question about the I-
5 710 presentation that CALSTART gave. And I was
6 wondering if that zero emission zone would be enforced
7 through any kind of regulation or just an incentive-
8 based program, kind of how you see that playing out?

9 COMMISSIONER SCOTT: So, thank you for that.
10 I'm looking around the room and I'm not sure that we
11 have either our SoCal Gas presenter, and I don't see
12 John from CALSTART here, either, to help answer those
13 questions for you. So, I'm sorry about that.

14 Oh, go ahead, Jim.

15 MR. MC KINNEY: I think this may be one point of
16 clarification, if I'm understanding your question
17 properly, at least the first part of the question.

18 You know, to use natural gas as a vehicle fuel,
19 it has to meet all of the regulatory standards that
20 other fuels meet, so that's both, you know, the 2010
21 standard and then future standards that are coming up
22 that we've talked about today.

23 And I think part of Dr. Reed's presentation that
24 was important, and some other speakers spoke to this as
25 well, is that we are jointly funding technology

1 development to reduce the NOx emissions from natural gas
2 engines from .2 gram per brake horsepower down to .02
3 grams per brake horsepower, which is a substantial
4 reduction.

5 So, there is no relaxation of air quality
6 standards and regulations for any of the alternative
7 fuels that we've discussed today.

8 MS. NIGUERIEA: Okay, thank you.

9 COMMISSIONER SCOTT: Other questions from the
10 phone?

11 MS. RAITT: That's it, so then we will open up
12 the phone lines. Oh, we don't have anyone on the phone
13 lines so I think we're done with comments.

14 COMMISSIONER SCOTT: Okay. I had just a few
15 closing remarks and then I'll turn it back to my
16 intrepid IEPR team.

17 One, first, I really just wanted to say thank
18 you again to all of our presenters who came today and we
19 had a really rich set of information.

20 We did it on a pretty compressed time frame. I
21 mean, I feel like each one of the panels that we had
22 could have been a whole full-day workshop, or more to
23 really dig in and think through, and talk about this.

24 So, I appreciate the breadth and depth of
25 information that you brought to us today.

1 I also wanted to say thank you to Jim McKinney
2 for putting together such a terrific day. It's
3 informative, interesting, getting all of the terrific
4 high-level speakers to come and talk to us and make
5 their great presentations.

6 And as always, to our terrific IEPR team.

7 So, here's a couple of things that I heard as
8 themes throughout the day. I probably didn't catch them
9 all as we were going through.

10 But one of the things that I heard is how
11 important it's going to be to leverage our existing
12 project partners and leverage the infrastructure that we
13 have already.

14 That we need to accelerate the work that we are
15 doing in terms of both getting -- three different
16 things, getting the vehicles on the road, advancing the
17 technologies and building out the infrastructure.

18 I heard a lot about the importance of getting
19 the word out and education on all of the different
20 technologies and fuels that we talked about today, the
21 importance of societal acceptance.

22 And we didn't talk about it a lot today, but one
23 theme that I also hear in terms of getting the word out
24 is the equity issue.

25 And we heard from the Legislators and a large

1 set of folks on the first workshop on how important it
2 is to make sure that the benefits of this program get to
3 everyone in the State.

4 And so I think when we're looking at -- so, it's
5 much broader than what we're doing on passenger cars.
6 It's making sure that we have good infrastructure and
7 it's in places where everyone can use it.

8 It's making sure that we have great freight
9 options, good public transit options and everything is
10 sort of moving in a direction that helps people feel, in
11 one way or another, the benefits of the program.

12 We talked about how we definitely need all the
13 parts of the portfolio and they're all going to have to
14 work together.

15 And that, again, went back to our theme of
16 accelerating the work that we're doing and we need all
17 of these areas to work together.

18 We talked -- two things that I heard. One was
19 on both the technology for waste to energy and on the
20 technology for hydrogen high-pressure systems.

21 And both of those things have been demonstrated
22 and are successful. And what we're trying to do right
23 now is move them from the areas where they were into a
24 new set of areas. And so, that was just something that
25 I was struck by with both Daniel and Julia's

1 presentations.

2 We talked about the utilization rates of the EV
3 charging stations, but also the rest of the
4 infrastructure.

5 We talked about how the components of the
6 different technologies are really important. And we
7 looked at that in decreasing the cost of the hydrogen
8 fueling stations and the components there.

9 And developing the vehicle platforms, we heard
10 in our first panel right after lunch. And so, how do
11 you -- where can we find economies of scale?

12 And we also talked about the importance of
13 volume, and scaling and commercialization of all of
14 these technologies of fuels and, again, the importance
15 of that and accelerating it.

16 And then three other, little things is, again,
17 keep working together in partnership. We heard a lot
18 about making sure that we keep it simple. And the
19 importance of that at the end of the day is to make sure
20 we have happy drivers or happy riders and clean, low and
21 zero emission vehicles.

22 So, thank you again to everyone for coming. I
23 appreciate all of the great thoughts and your expertise.

24 And I'll turn it back to Heather for any final
25 remarks.

1 MS. RAITT: Yeah, I would just like to encourage
2 folks to submit written comments and request them due by
3 April 24th. And there's information here and on the
4 notice about how to do that. That's all.

5 COMMISSIONER SCOTT: Thank you.

6 (Thereupon, the Workshop was adjourned.)

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TRANSCRIBER'S CERTIFICATE

I do hereby certify that the testimony in the foregoing hearing was taken at the time and place therein stated; that the testimony of said witnesses were transcribed by me, a certified was under my supervision thereafter transcribed into typewriting.

And I further certify that I am not of counsel or attorney for either or any of the parties to said hearing nor in any way interested in the outcome of the cause named in said caption.

IN WITNESS WHEREOF, I have hereunto set my hand this 21st day of May, 2014.

A handwritten signature in cursive script, appearing to read "Barbara Little", is written over a horizontal line.

Barbara Little
Certified Transcriber
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